MECHANICAL ENGINEERING

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ASME International Meeting, Mexico City, Mexico, March 10-12, 1954

This Bailey Boiler Control Panel insures high efficiency in the use of Fuel-Dollars at a Western Chemical Plant.

What's Your Fuel-dollar Efficiency?

A dollar's worth of fuel has the *same potential* energy, no matter who's boiler it fires. But how much of the energy actually gets converted to a usable form depends on how you operate your boiler.

That's where Bailey Controls can help. And, here's why, we believe, you'll get better fuel-dollar efficiency with Bailey:

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2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's Sales-Service Engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better fuel-dollar efficiency—for more power per fuel-dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

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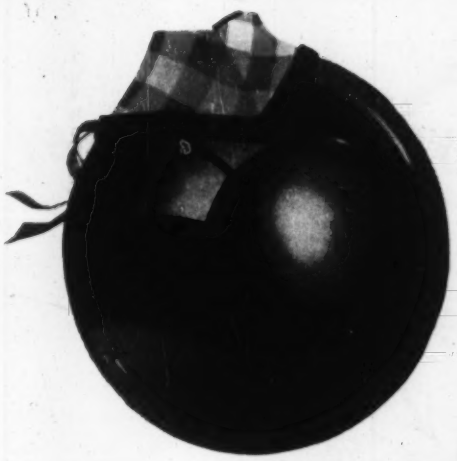
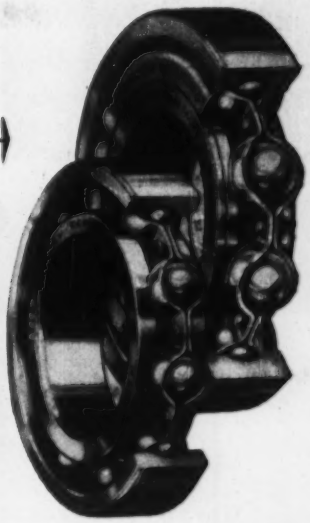


Money Savers in Motors and Machinery



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Cutting down on "down-time" is just one of the many contributions New Departure **ball** bearings have made to the machine age. For New Departures have proved themselves in countless applications, from electric motors to heavy industrial machinery. They take radial and thrust loads—or *any* combination . . . preserve accurate alignment of parts . . . reduce friction . . . require no adjustment for wear—and *virtually no maintenance!* Throughout industry, designers and engineers specify New Departure **ball** bearings for top performance.

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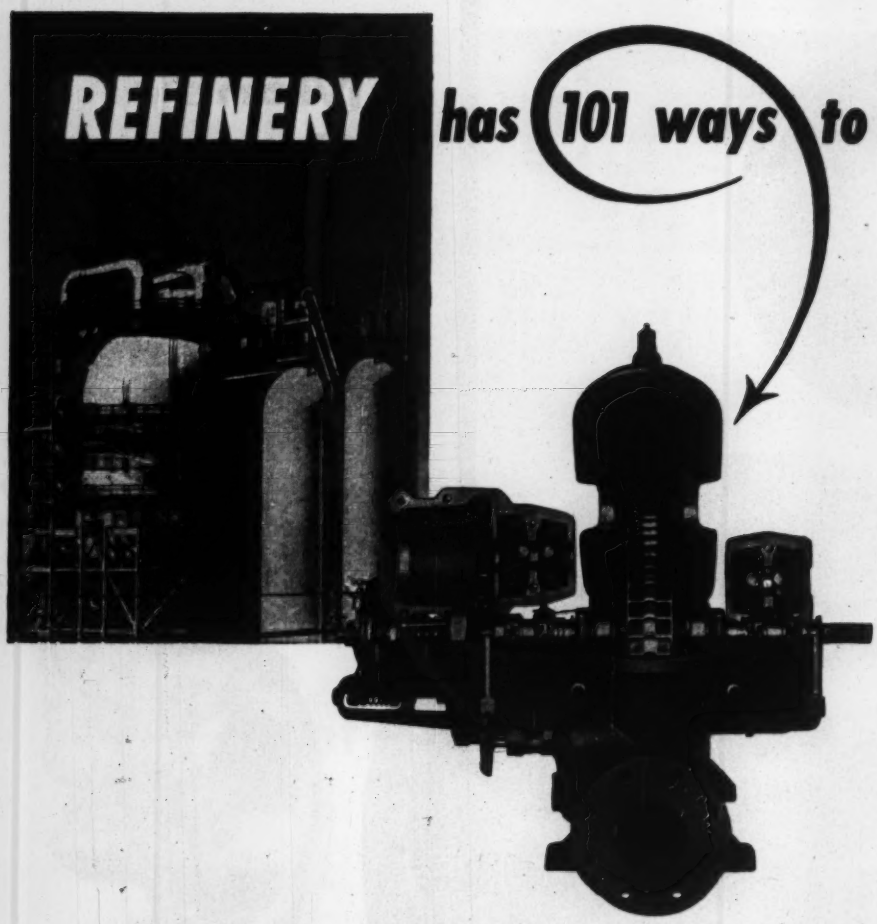
REFINERY has 101 ways to save money



When the yearly cost of replacement parts for 101 steam turbines averages *only 1.6% of the initial investment*, you are saving money . . . and plenty of it.

This amazing record was established by Terry turbines at a large refinery on the Atlantic coast. The percentage figure was determined by means of an accurate tabulation of the cost of replacement parts required over a two-year period.

These 101 Terry machines provide a good cross section of the various types of small and medium-size turbines made by the company. Ranging in size from 10 to 1200 horsepower, they include single and multistage axial flow designs as well as the famous Terry solid-wheel turbine.

Such outstanding performance records are not at all unusual for Terry turbines. The thousands and thousands of these machines installed in refineries throughout the world provide an accurate yardstick for measuring turbine reliability.

Send for illustrated bulletins. No. S-116 describes the many advantages of the Terry solid-wheel turbine. For multi-stage turbines, ask for a copy of Bulletin S-146.

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THRUST STANDS

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Production Test and Flight Test both need accurate information about the performance of the plane under test, and particularly the net static thrust.

The builder's rating of engines under standard conditions, and the predicted performance of the assembly are important, but the actual performance, under ambient conditions, is vital to safe operation.

During the past five years, test after test has proven the accuracy, reliability and versatility of both fixed and portable thrust stands equipped with Hagan ThrusTorq units. The number and size of the Hagan ThrusTorq units used determine the capacity of a stand.

For example, the portable stand shown in the top photograph requires only stop pieces bolted to the apron. It will take any load up to 25,000 pounds of thrust. Each unit has its own supply of bottled nitrogen, used as a power source for the Hagan ThrusTorq. The stands can be set to accommodate the span of the landing gear of the plane under test.

The fixed type, shown in the center, uses Hagan ThrusTorq force measuring units. It is installed flush with the apron, and will test any plane with up to 45,000

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AERONAUTICAL AND SPECIAL PRODUCTS DIVISION
HAGAN BUILDING, PITTSBURGH 30, PA.

•

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METALLURGICAL FURNACE CONTROL SYSTEMS
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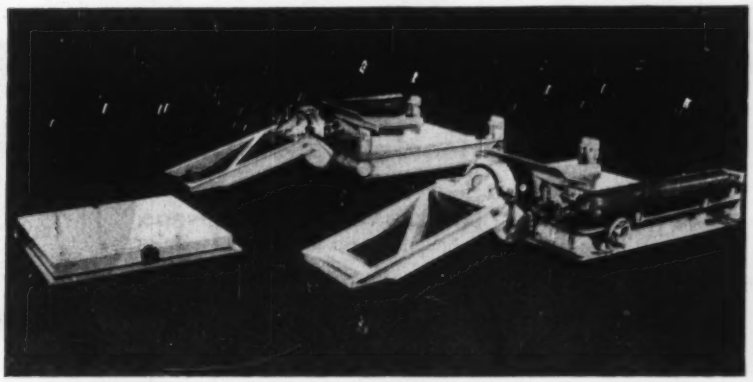
continuous readings of static thrust . . .

pounds thrust. It can be used with either compressed air or bottled nitrogen.

The Hagan ThrusTorq unit, shown below, is a pneumatically operated mechanism designed to produce a signal pressure directly proportional to the force imposed on it. It is fast, economical and clean, and is operable in any position. Signals produced are suitable for actuating indicators or recorders, either at the stand or remotely.

The Hagan ThrusTorq may also be used for rocket thrust measurement, jet engine thrust measurement, cradle dynamometer measurement of aircraft engines, and in many other applications.



Complete Portable Thrust Stand showing nose wheel unit and thrust measuring units in relative operating positions.

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BIG TRUTH*

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***The only safe way to select boilers is on nominal capacity to operate at "cruising speed"...**

KEWANEE reserve plus rating

guarantees dependability, higher efficiency, lower costs, longer life—because it means "cruising speed" operation.

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So when you consider "bidding data" be sure you compare like examples . . . know whether ratings are based on maximum capacity or nominal capacity.

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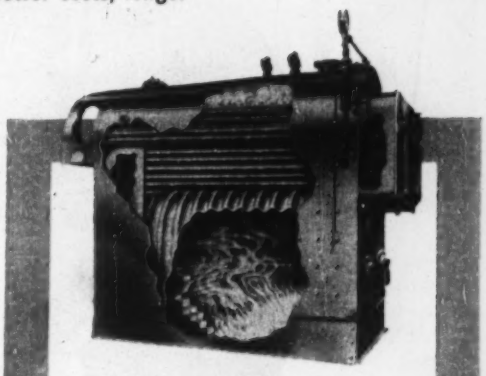

Kewanee type "C" boiler
with exclusive corrugated crown sheet
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3650—42500 sq. ft. steam
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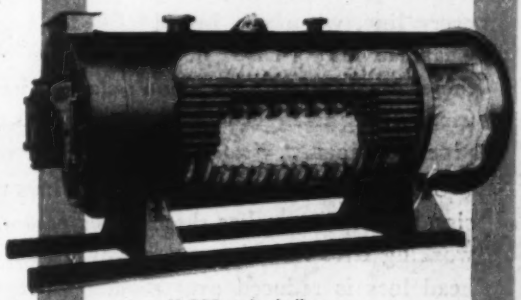

M-800 series boiler

Here is the rugged "M-800" Series Scotch Boiler constructed in 13 sizes for high pressure steam 39 to 304 horse power and low pressure 15 lb. steam or 15 lb. water.

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QUIET

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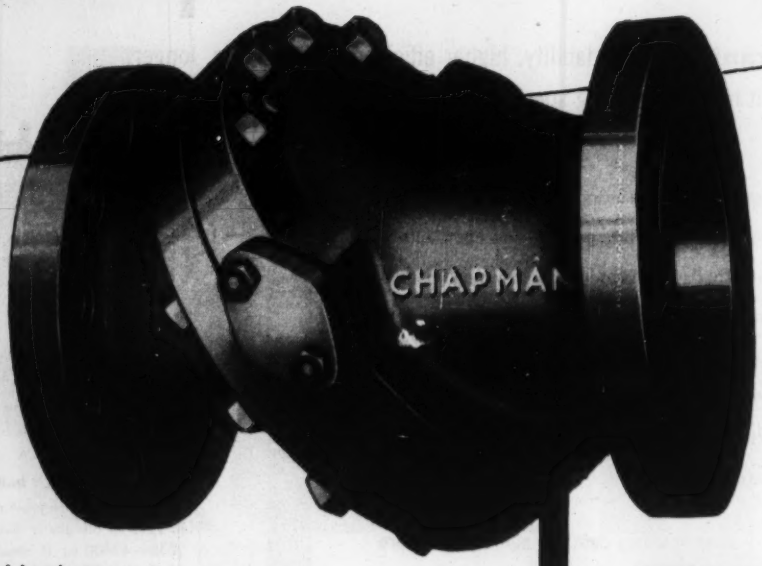

You hang this sign on every line, when you install Chapman Tilting Disc Check Valves. For these unique check valves don't slam or hammer, under usual piping arrangements. And that means no damage to pipeline joints . . . virtually no wear in the valve itself.

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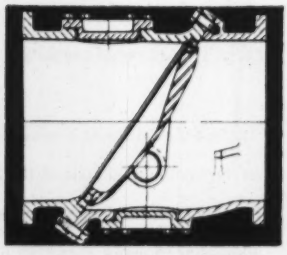

Here's why
CHAPMAN Tilting Disc Check Valves
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This specially designed "airfoil" disc balances perfectly in open position . . . then drops easily to closed position (cushioned by the flow). No jarring or slamming, in usual pipe-layouts. Write for bulletin.

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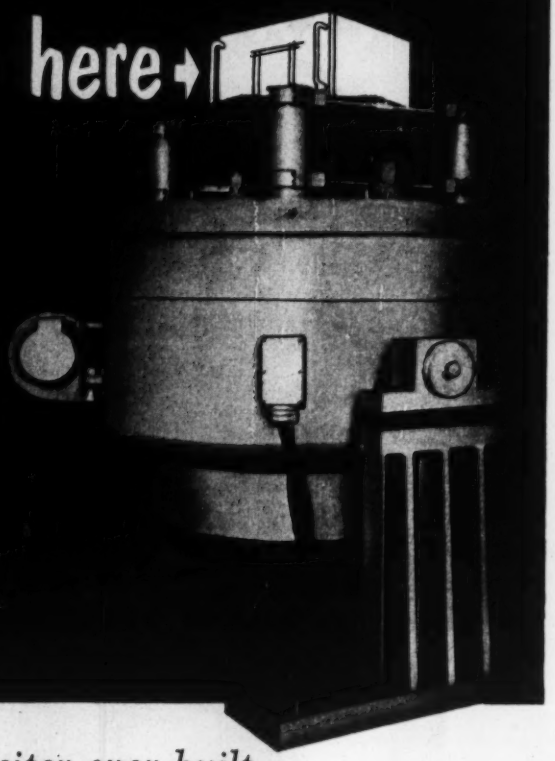

MB produces the largest exciter ever built to meet heavy duty vibration test specifications

THERE's nothing like a good shaking to test out structural designs, electronic equipment, instruments or complete assemblies for faults or flaws. In fact, for many products put to military use, such tests are *specified*. However, since *all* products encounter some vibration or shock in service, many engineering departments use an MB Exciter to test all designs. By so doing, the "bugs" are discovered in the test laboratory instead of out in the field, at cost of good will.

Largest in the line of MB electromagnetic shakers, the Model C-100 shown delivers at least 5 tons continuous force. Its performance permits heavy duty vibration testing to MIL-E-5272 and other specifications. It incorporates a number of unusual design features for easy, quick, convenient operation—including interlocking controls for complete safety and provisions for cycling tests.

HOW TO HANDLE LARGE MASSES

MB can show you a setup of vibration exciter and resonating beam that multiplies the capacity of versatile MB Exciters many fold. Shaker being used in this fatigue strength test of aircraft engine mounts is the model S-3 rated at 200 lbs. Others available down to 10 lbs. force output.

Vibration is MB's specialty. You're invited to draw on the benefits of this specialization—and get highly qualified products for testing and control, and technical help on your problem.

Valuable bulletins for test engineers Calibrating vibration pickups to 2000 cps is comprehensively covered in MB Bulletin No. C-11-4. Bulletin No. 1-VE-4 describes vibration exciters and details their specifications. Write today.

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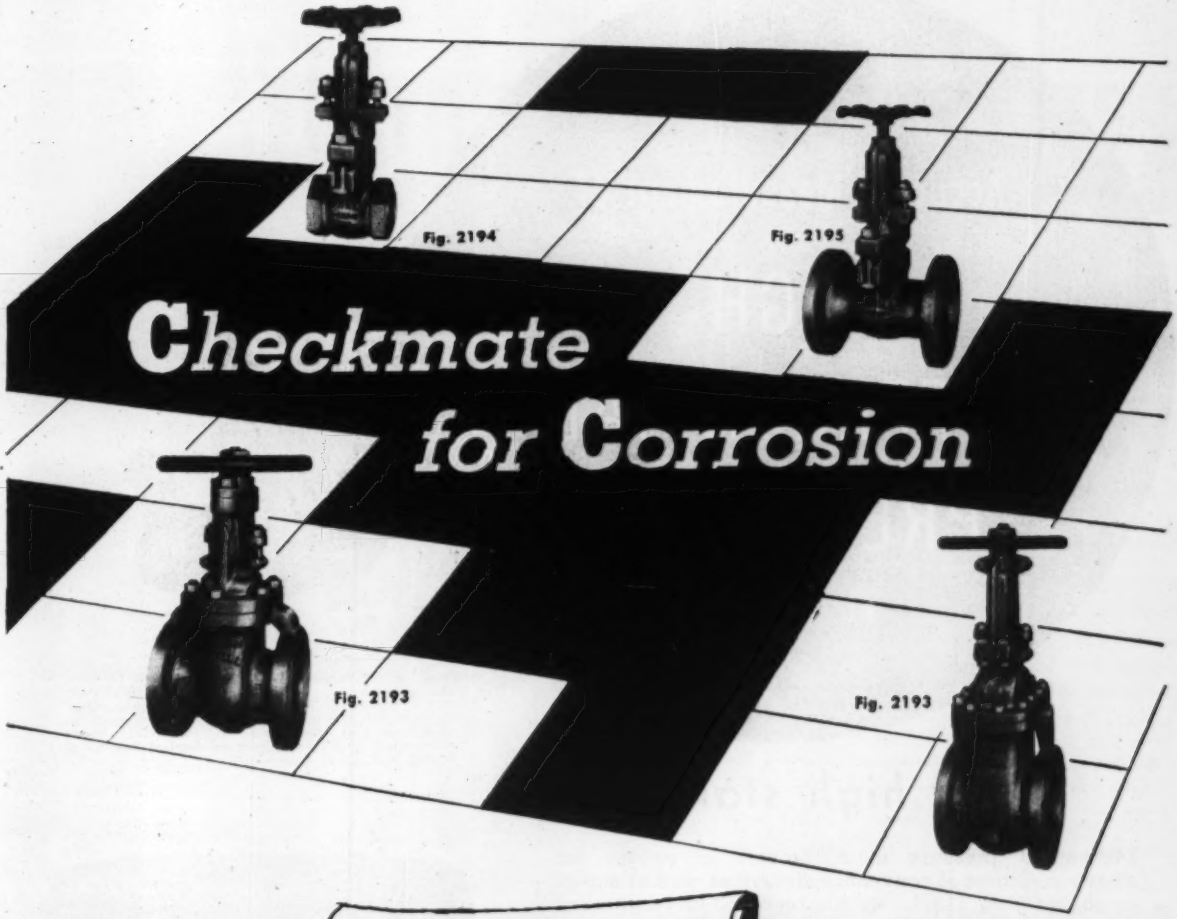

GATE VALVE *(upper left)* **Fig. 2194** for 225 pounds W.O.G. Screwed ends, bolted flanged bonnet, inside screw rising stem. Body and bonnet are made of Ni-Resist, with 18-8S Mo Stainless Steel (Type 316) stem, seats, and wedge. Sizes ¼" to 2", inclusive.

GATE VALVE *(upper right)* **Fig. 2195** for 200 pounds W.O.G. Flanged ends, bolted flanged bonnet, inside screw rising stem. Ni-Resist body and bonnet, with stem, seats, and wedge made of 18-8S Mo (Type 316) Stainless Steel. Sizes 1" to 3", inclusive.

GATE VALVE *(lower left)* **Fig. 2193** for 200 pounds W.O.G. Flanged ends, bolted flanged bonnet, outside screw rising stem and one-piece yoke. Body, bonnet, and yoke are Ni-Resist. Stem, seats, and wedge are 18-8S Mo (Type 316) Stainless Steel. Size 4".

LARGE SIZE GATE VALVE *(lower right)* **Fig. 2193,** 5" to 12", inclusive, for 200 pounds W.O.G. Flanged ends, bolted flanged bonnet, outside screw rising stem and two-piece yoke. Ni-Resist body, bonnet, and yoke, with 18-8S Mo (Type 316) Stainless Steel stem, seats and wedge faces.

It's a winning move every time you select Powell *Ni-Resist* Valves. For here is an alloy that has far greater corrosion and heat resistance than ordinary Cast Iron. Similar to gray iron, and resembling austenitic stainless steel in many ways, no other cast metal offers such a unique combination of useful properties.

Powell Ni-Resist Valves are especially adapted for handling pulp and paper mill liquors, oil refinery acids, alkalies and sludges, caustic soda, pickling solutions, sea water and many other fluids. Shown here are just a few of them to help you checkmate the high cost of corrosion. They're available through distributors in principal cities. If a distributor is not located near you, just write us—The William Powell Company, Cincinnati 22, Ohio. We'll be pleased to tell you more about these valves—or to help you with your valve problems. Powell has probably solved more valve problems than any other organization in the world.

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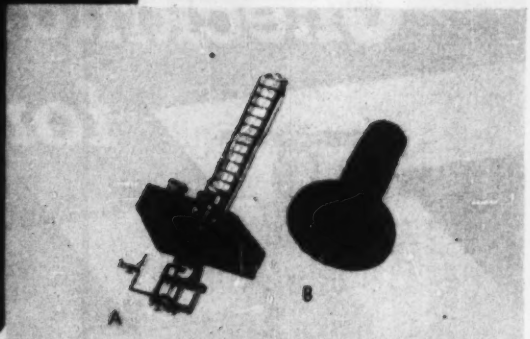

Heart of the Foxboro Type EH Differential Pressure Controller (below) is the heavy-duty stainless steel helical measuring element (A) with its alloy-steel housing (B). This assembly is mounted at rear of instrument case, the motion of the helical being transmitted to the instrument mechanism through a friction-free pressure seal bearing.

...at high statics!

Differential pressure measurements at ranges far above the limits of conventional devices, and at statics up to 2200 psig, can be readily recorded and controlled by the new Foxboro Type EH Instrument.

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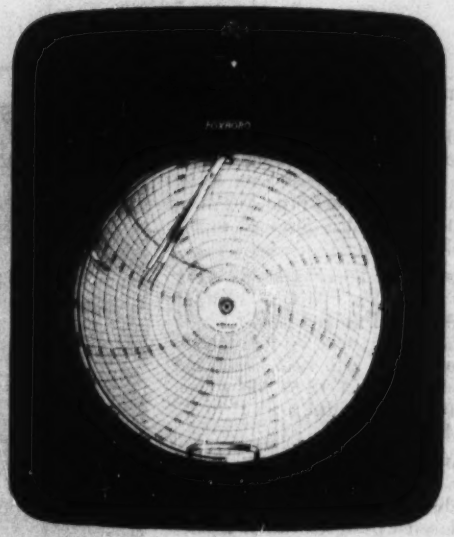
Many large steam generating plants have installed Type EH Instruments to control differential pressure across boiler feed valves, thus assuring at all times that the boiler feed pump is operating at pressures high enough above boiler pressure to assure safe operation.

Differential pressure ranges are available from 0-100 psig minimum to 0-2200 psig maximum. Design of the helical actuating element assures precision over the entire measuring span. Heavy-duty construction of the element and its housing makes operation safe.

Write for details on Foxboro Type EH Instruments for indicating, recording, controlling, transmitting.



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Built of stainless steel and fully enclosed, Link-Belt screens eliminate splash and escape of sulphur dioxide vapors at Staley. Cover of first screen has been removed for photo. Link-Belt drive and conveyor chains are also used on leading corn-picking machinery.

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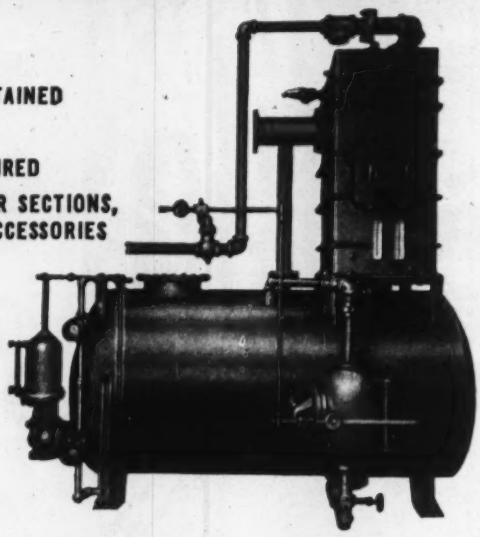

Here's the deaerator every small and medium-size plant has been waiting for!

Now for the first time you can get a ready-to-install deaerator that will give you high quality boiler feedwater at extremely low cost. The UNI-PAC DEAERATOR is guaranteed to deliver water with an oxygen content not to exceed 0.005 c.c. per litre (less than 7 p.p.b. billion)—generally recognized as zero oxygen!

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ME-1

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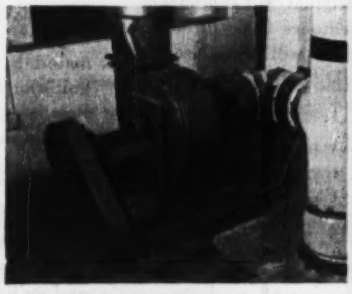
Better Air

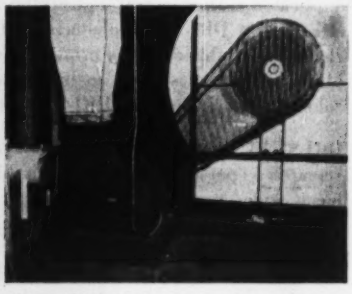
for tomorrow's chemical research

Wyandotte Chemicals Corp. chooses American Blower equipment for new multi-million dollar research building

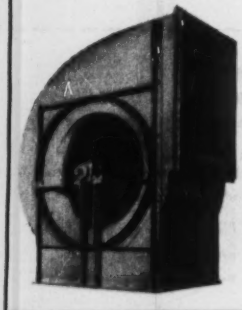
Air — the right kind of air, properly cleaned, conditioned and humidified — is a vital necessity in a modern chemical research laboratory. That's why Wyandotte Chemicals Corp. chose American Blower equipment for their highly functional new research building which has complete air conditioning in every laboratory. American Blower engineers have a complete knowledge of the air cycle and the special problems of many industries. Whenever you have an air handling problem give your nearest American Blower or Canadian Sirocco Branch Office a call.



Individual laboratory exhaust fans (rubber covered and corrosion resistant) have two speeds: slow for normal exhaust; high for experimental work. This allows the chemist to completely control room and hood ventilation.



Secondary air is supplied by an American Blower HS fan with humidifier and dehumidifier, heating and cooling coils. Fan in foreground is American Blower utility set used to ventilate hard-to-reach areas such as stairways, etc.



American Blower Series 81 Sirocco Fan. All Sirocco Fan ratings are certified in accordance with the Standard Test Code.

AMERICAN BLOWER CORP., DETROIT 32, MICH. • CANADIAN SIROCCO CO., LTD., WINDSOR, ONT.
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

New facts for your file on

U·S·S STAINLESS STEEL

SHEETS · STRIP · PLATES · BARS · BILLETS · PIPE · TUBES · WIRE · SPECIAL SECTIONS

Stainless Steel is used in the compartments of this car—a new idea in bulk transportation of dry, granular materials. The hopper car was built by General American Transportation Corporation, Chicago.

GATX makes good use of Stainless Steel in Trans-Flo car

● Here's an entirely new idea in bulk transportation of dry, granular materials made possible by the use of Stainless Steel. It's a covered hopper type of car, designed and built by General American Transportation Corporation, Chicago, Ill.

The car is divided into two large compartments, each with six hoppers. For some commodities the upper portion of each of the compartments is Stainless Steel. Whereas, for pharmaceuticals each compartment is fabricated of Stainless Steel.

By the use of Stainless Steel, the danger of rust from condensation in the air space above the lading is eliminated. And because Stainless is so easy to clean and keep clean, it helps to guard the commodity against any possible contamination.

The exterior of this fruit and vegetable store display is long-lasting, corrosion-resisting Stainless Steel. The unit is manufactured by The Super-Cold Corporation, Los Angeles.

"Cold moist" vegetable display unit is built to last with Stainless Steel

The Super-Cold Corporation, Los Angeles, Calif., is relying on Stainless Steel to add both good looks and long life to its "Salesboy" fruit and vegetable store display.

This unit features the addition of cold moisture to the refrigeration unit to combat the effects of warm temperature and dry air. This maintenance of moisture content virtually eliminates sorting and trimming, as well as a large percentage of shrinkage loss.

The entire exterior of the unit is Stainless Steel, a material that will maintain attractive appearance for years even when exposed to a damp, moist atmosphere.

Take advantage of Stainless Steel in your designs and in your selling

Here are more applications typical of the thousands in which Stainless Steel has been used to improve design and add sales appeal. The wide range of valuable properties available in Stainless Steel makes it the ideal material for many, many jobs.

Put Stainless to work for you. It will pay its own way and give you a good return on your investment—especially when it is perfected, service-tested U·S·S Stainless Steel.

USS

UNITED STATES STEEL CORPORATION, PITTSBURGH · COLUMBIA GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. · UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS

UNITED STATES STEEL

New facts for your file on

U·S·S HIGH STRENGTH STEELS

Built 1000 lbs. lighter with USS COR-TEN steel

dump trailer hauls more, costs less to operate, will last longer

● At an extra cost of only thirty dollars for USS COR-TEN steel, the Trailmobile Co., Cincinnati, Ohio, has trimmed 1000 lbs. of deadweight off this 26½ cu. yd. dump trailer. As a result, it can haul one-half ton more payload without any increase in loaded weight over a similar unit built of ordinary steel, and operating costs per ton moved are materially reduced.

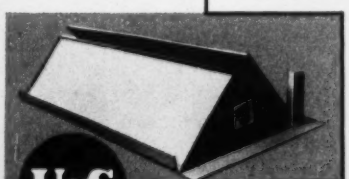
But USS COR-TEN steel does more than save weight and lower operating costs. Its high yield point of 50,000 psi—one and a half times that of carbon steel—gives the trailer body exceptional strength and toughness. Its much higher resistance to atmospheric corrosion, its superior resistance to abrasion, impact and wear greatly increase durability, keep the trailer on the job and help to prolong its life.

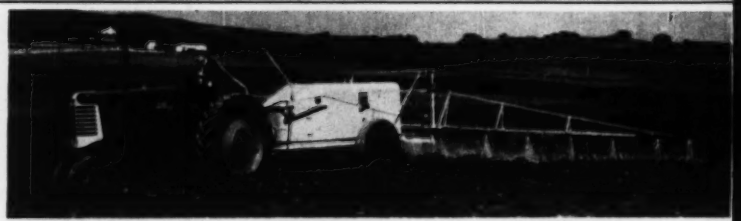
Since its introduction twenty years ago, USS COR-TEN steel has been used by 27 leading builders of trucks and trailers—names famous in the commercial car industry—to produce equipment that is lighter, more durable, able to do more work and cheaper to operate and maintain. For the complete story of USS COR-TEN and other USS High Strength Steels, write our nearest office.

In fireplace damper, USS COR-TEN steel gives corrosion resistance, adds durability . . . and cuts costs

Designers who usually think of USS COR-TEN steel in connection with mobile equipment—such as trucks and trailers, buses, earth movers and similar equipment, where its ability to reduce weight and increase durability are a matter of record—are sometimes surprised at the effective way this high strength steel's properties are put to use in applications like this.

Here in a fireplace damper, USS COR-TEN steel shows how advantageously it can be used to improve stationary equipment as well. Says Fred W. Donley of Donley Brothers Company, Cleveland, Ohio, the manufacturer, "As to the reasons for using COR-TEN steel instead of ordinary carbon steel, we desired a material similar to cast iron in resistance to corrosion under coal smoke conditions. The COR-TEN steel damper began as a substitute for cast iron during the war, but has earned a place of its own because of its sturdy construction and a price that is less than cast iron in the respective sizes."





USS COR-TEN steel improves farm sprayer performance by reducing corrosion difficulties

In order to reduce troubles due to corrosion, the Oliver Corporation, Chicago, Illinois, has standardized on the use of USS COR-TEN steel for its row crop sprayer.

By building sprayer tanks of USS COR-TEN steel the manufacturer claims to have obtained these very worthwhile advantages: (1) COR-TEN steel tanks corrode far less rapidly than carbon steel tanks. (2) The rust which comes off the COR-TEN steel is very fine and does not clog the sprayer screens, whereas carbon steel rust comes off in flakes which plug the screens, causing delay because the equipment must be shut down to clean screens. (3) Users get a better product and are better satisfied. "As a result," says the Oliver Corporation, "we intend to make all of our sprayer tanks of COR-TEN steel."

USS

New facts for your file on

U·S·S CARILLOY STEELS

Special non-magnetic U·S·S Carilloy steel anchors Navy's newest minesweeper

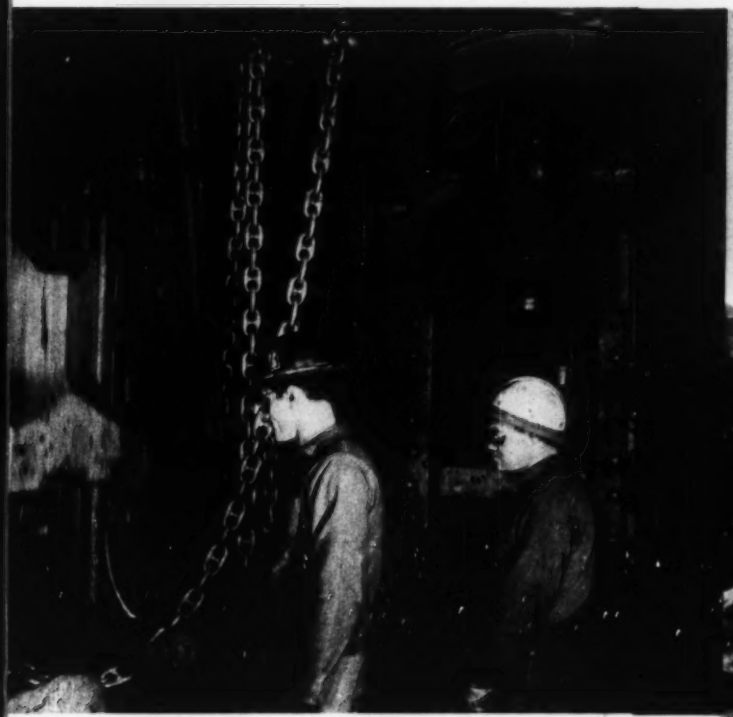
● The United States Navy has made minesweeping operations more effective with the help of U·S·S Carilloy steel.

During World War II, a new weapon in marine warfare was developed —the magnetic mine. These mines explode when an ordinary steel ship comes near. To sweep such mines safely, without premature or uncontrolled explosions, the Navy is building a fleet of radically new *non-magnetic* minesweepers.

Finding a suitable steel for the anchor chains on these ships was quite a problem. The chains scrape over hard rocks, sand, and coral along the ocean floor, so they must have good resistance to abrasion. In addition, they must withstand heavy tension, torsion, and impact stresses as wind and tide pound at the ship. To top it off, they must be non-magnetic.

The Navy satisfied *all* these tough requirements with Carilloy austenitic manganese steel. Intimate knowledge of steels and accurate, skillful control of each step in steel making enabled us to meet the unusual specifications.

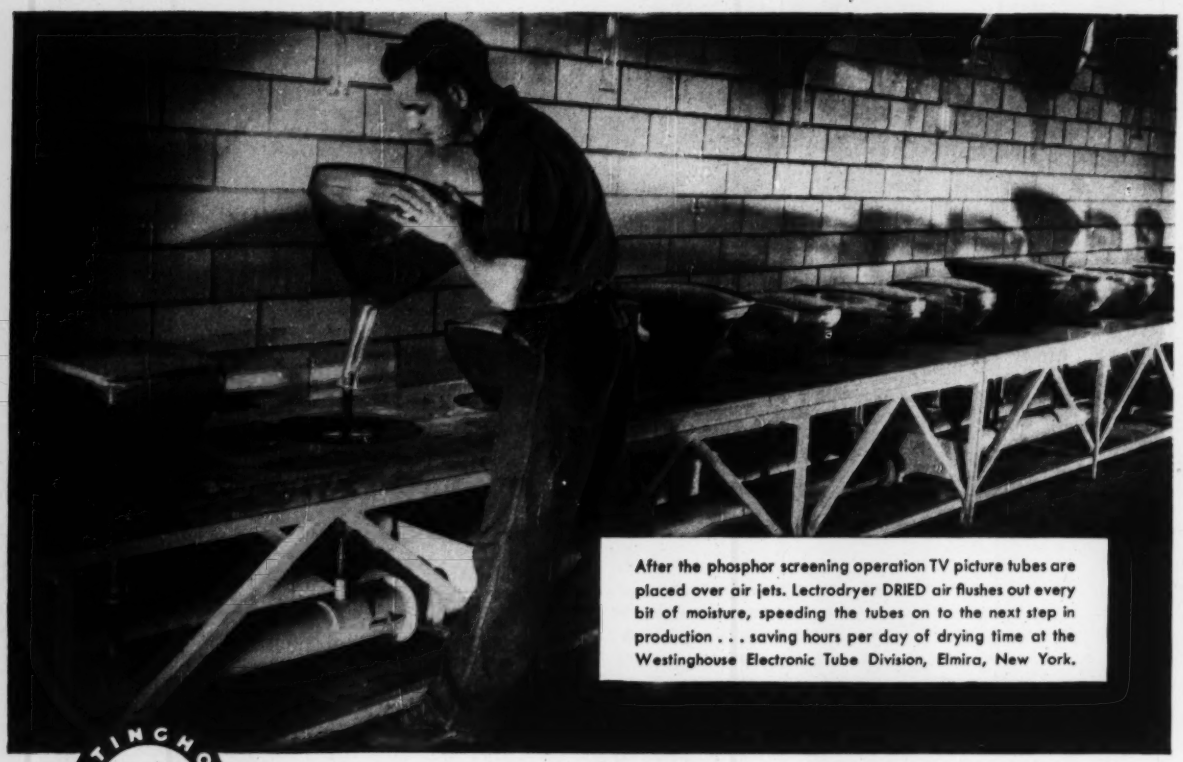
Experience on extraordinary jobs like this helps us to do a better job on your steel, whether you need a standard AISI grade or a special analysis. When you need high-quality alloy steel, specify U·S·S Carilloy. And when you need expert metallurgical advice, get in touch with the nearest U·S·S District Sales Office.



NON-MAGNETIC ANCHOR chains are forged from U·S·S Carilloy austenitic manganese steel. They are cooled after forging.

LENGTH of this ¾" anchor chain is checked after proof test loading at Boston Naval Shipyard. Ductility is extremely important in these chains, and the U·S·S Carilloy steel provides elongation of 80%.

U·S·S



After the phosphor screening operation TV picture tubes are placed over air jets. Lectrodryer DRIED air flushes out every bit of moisture, speeding the tubes on to the next step in production . . . saving hours per day of drying time at the Westinghouse Electronic Tube Division, Elmira, New York.

® TV tubes DRY so fast you can see the moisture disappear!

After applying the phosphor coating to picture tubes they must be dried. Ordinarily, this is a slow process. To speed this action, Westinghouse flushes the tubes with warm, DRY air. Production lines flow faster, and more uniform drying of the phosphor particles is assured.

A Lectrodryer* dries the air for this operation. These same machines can DRY air, gas or organic liquids to meet DRY conditions you may predetermine. Relative humidity as low as 10% can be obtained in areas as large as a warehouse. Dewpoints lower than −110° F can be reached.

Such DRYness speeds up production, reduces spoilage, protects materials and keeps chemicals reacting properly for many manufacturers. Lectrodryer may be your answer to troublesome moisture problems.

Write for *Because Moisture Isn't Pink*, a booklet describing Lectrodryer machines of all types, their function and how they're working for others. Pittsburgh Lectrodryer Corporation, 335 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

*REGISTERED TRADEMARK U.S. PAT. OFF.

Established 1888

D.O.James

CENTRALLY DRIVEN BALANCED DRIVE
With Great Emergency Strength

GEAR SPEED REDUCERS

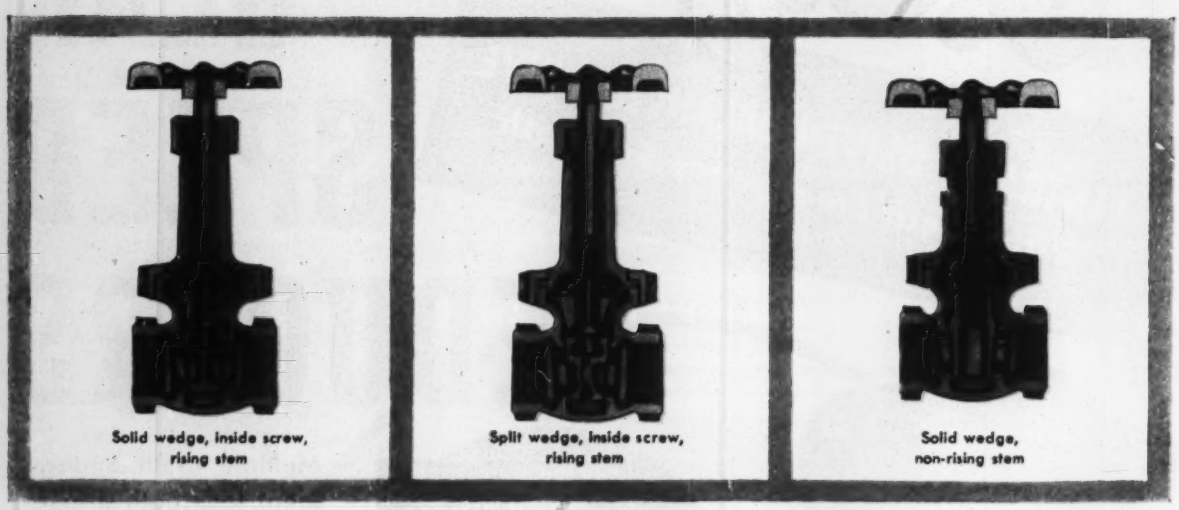
Multiple tooth engagement, low tooth stresses, with high load capacity and high wear factor. Gears are heat treated, shaved and crowned (Elliptoid), equally balanced and revolving in same direction, quiet operation, long gear life, and highest efficiency.

Catalogs are available containing complete engineering data.

D.O.JAMES GEAR MANUFACTURING CO.

1140 WEST MONROE STREET • CHICAGO 7, ILLINOIS

Oh, I see



Solid wedge, inside screw, rising stem

Split wedge, inside screw, rising stem

Solid wedge, non-rising stem

. . . we've added 125 and 150 lb. bronze gate valves to our union bonnet line

WORKING PRESSURES
125 lb. W. S. P. 400° F.
150 lb. W. S. P. 400° F.

Success of our 200 lb. line of union bonnet bronze gate valves necessitates expansion of the line to include 125 lb. and 150 lb. classes. Sizes range from ¼ to 2 inches.

NOTE THESE ENGINEERING FEATURES:

This line has a flat seat on the bonnet which mates against the body, providing adequate bearing area for sealing.

Tight bonnet joint, but easy access to interior for inspection and service.

Full ports permit unobstructed flow.

Back-seating arrangement permits repacking while under pressure.

Split wedge has ball in socket contact . . . permits wedge to adjust itself to seat.

Slip-on type "T" head stem-to-wedge connection.

Lug-type hexes make valves compact and provide a better wrench-gripping surface.

To learn more about this expanding line of valves, write for our *Union Bonnet Bronze Gate Valve Catalog Folder.*

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

OIC **VALVES** | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON**

VERS-O-TOOL

CHOICE

A

CIRCULAR GROUND THREAD CHASER HEAD SIZES: 3/16 - 6½"

ADJUSTABLE BLADE CHASER HEAD SIZES: ⅜ - 2"

B

It's this simple...you start with a precision built self-opening die head —the Vers-o-tool—then just choose either of two types of chasers least costly for the job.

A If it is a long run job—specify circular ground thread chasers. They give you maximum chaser life by any comparison, regrind to a full 270° circumference. Up to 10,000 threads per grind on screw stock isn't unusual.

B For smaller lot threading—use the Namco Adjustable Blade type chasers, also with ground threads.

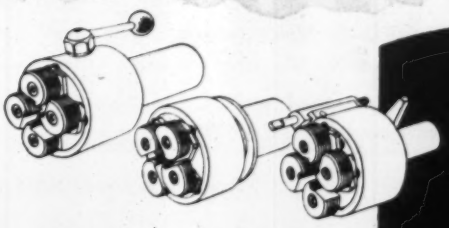
Both styles are interchangeable, head size for head size, between revolving and non-revolving Vers-o-tools.

ONE VERS-O-TOOL and SELECTIVE CHASERS . . .

cuts your threads . . .
cuts your tool investment
and cuts your operating costs

This system also includes a Namco Micrometer Gage, which checks the chasers—does away with trial cuts after grinds, gives many more pieces per grind, reduces reject losses and saves wasting expensive man-hours. Class 3 threads are guaranteed—and smoother.

Every month, more threading departments join our lists of exclusive Vers-o-tool users. Maybe you'd like to try out this double-duty head. If rising costs are your problem—you should. Send a sample with "specs," large or small run, and we will show you. Ask for Catalog DT-52.



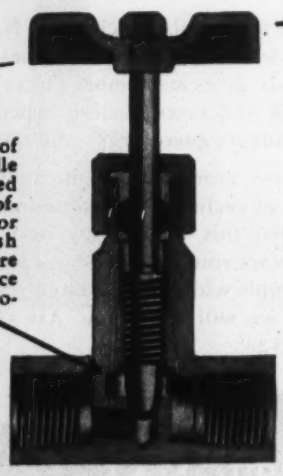
The NATIONAL ACME COMPANY

170 EAST 131st STREET • CLEVELAND 8, OHIO

ACME-GRIDLEY BAR and CHUCKING AUTOMATICS
1-4-6 and 8 Spindle • Hydraulic Thread Rolling Machines • Automatic Threading Dies and Taps • Limit, Motor Starter and Control Station Switches • Solenoids • Contract Manufacturing.

MAXIMUM WORKING PRESSURE
10,000 PSI
for water, oil or gas

- Body and stem guide extra heavy bar stock fused into one piece.
- Valve stem 416 stainless steel.
- Packing special one-piece "Marpak" moulded ring.
- Bodies marked in accordance with MSS regulations.



ONE PIECE

The stem guides of conventional needle valves are screwed into bodies—this often causes leakage or blow-outs. Marsh Needle Valves are fused into one-piece by exclusive "Conoweld" process.

Introducing-

The Ultimate in Needle Valves

Here is one of the crowning achievements of Marsh research, design, and manufacturing skill. It is the first needle throttling and shutoff valve to combine *all* of the qualities called for today in this highly critical and ever broadening field.

It is a valve that has strength and safety to spare . . . rated for pressures up to 10,000 psi—equally efficient in the lower ranges. A product of Marsh instrument-making and valve manufacturing experience, it combines instrument-like precision with the ruggedness that distinguishes all Marsh valve specialties.

The illustrations tell the story of new thinking; new standards. Body and stem-guide are machined from extra-heavy carbon steel bar stock. Still greater strength and rigidity are achieved by fusing the stem-guide into the body. The complete fusion of guide and body is accomplished by the exclusive Marsh "Conoweld" process.

There are two big advantages to this one-piece construction: (1) It eliminates the danger of unscrewing the valve from the body when opening—a frequent cause of leakage, even dangerous blow-outs (2) It permits perfect line-up of threads and seat. As a result, Marsh valves are easier to operate even at high pressures.

The precision-machined stem is 416 stainless steel. Stem threads are fine pitch for extra strength and fine, controlled regulation. Notable advancements are special "Marpak" one-piece, non-binding longer-lasting packing; deep thread chambers, keeping inlet and outlet piping away from ports and contributing excellent flow characteristics. Entire packing nut and packing gland are electro-zinc plated, preventing corrosion and giving the valve a handsome, plated exterior. The rugged malleable handle is finished in heavy baked enamel.

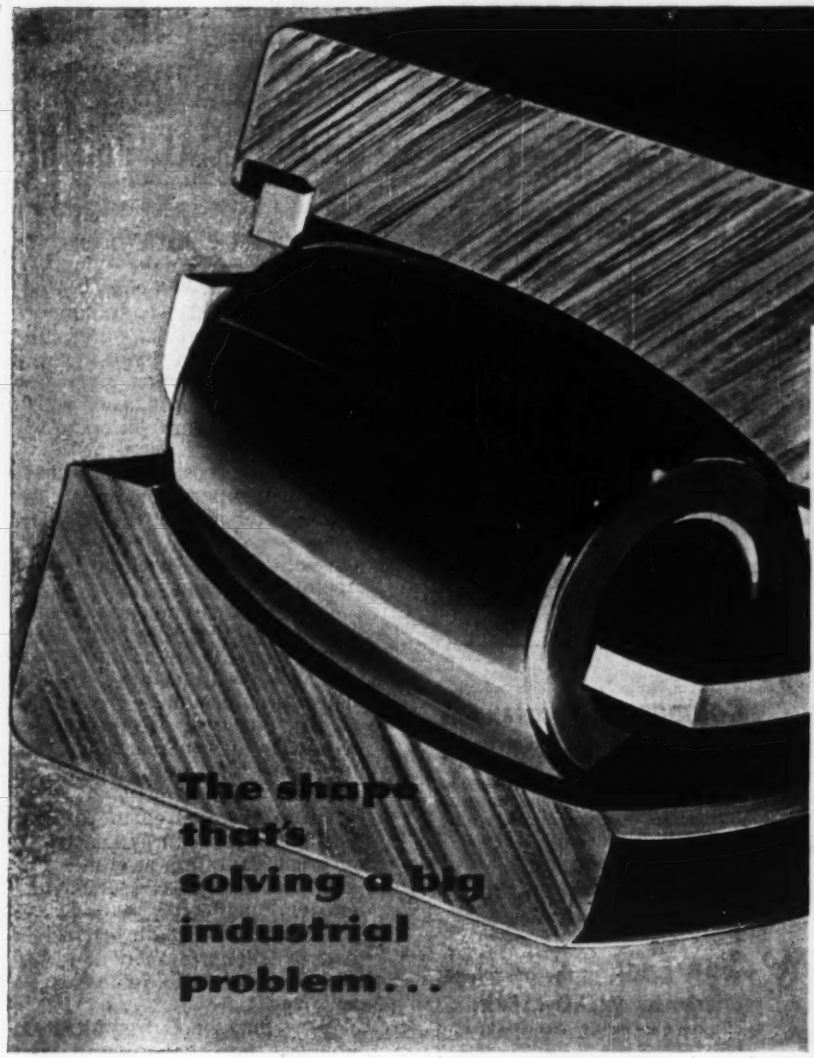
The new needle valve line includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾" and 1". Also globe and angle valves with male inlet and female outlet in sizes ¼" and ½". *Complete stock carried at our Skokie, Illinois factory and also at our branch plant in Houston, Texas.*

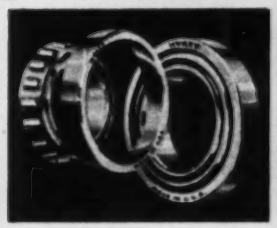
Write today for catalog giving complete details.

MARSH INSTRUMENT CO. *Sales affiliate of Jas. P. Marsh Corporation*
Dept. 29, Skokie, Ill.
Export Dept., 3501 Howard St., Skokie, Ill.

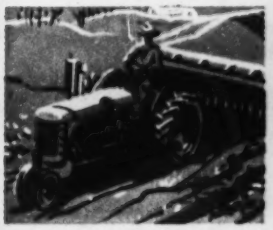
MARSH

"THE STANDARD OF ACCURACY"

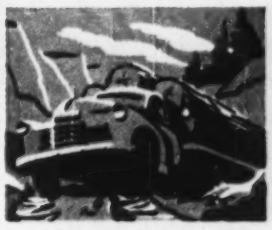




For tractors and implements . . .

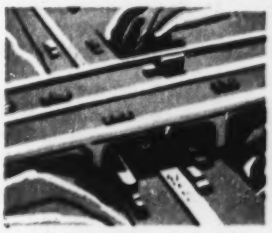


for cars, trucks and busses . . .



NEW HYATT BARREL BEARING!

You're looking at a cross section of industry's newest find—*the bearing that's built with barrel-shaped rollers!* Developed by Hyatt, the Barrel Bearing is of true dual-purpose design—it takes load from any direction. But more than that, the Barrel Bearing is self-aligning—and misalignment of supporting parts cannot cause excessive wear, as it does with ordinary bearings. Now in volume production, this new bearing is in the newest trucks and busses, in farm, textile and construction equipment, and in many types of oil field machinery. In fact, if you own a new car there's a good chance that Barrel Bearings are in the wheels and differential.



for construction equipment and many types of new machinery.

HYATT ROLLER BEARINGS

STRAIGHT BARREL TAPER

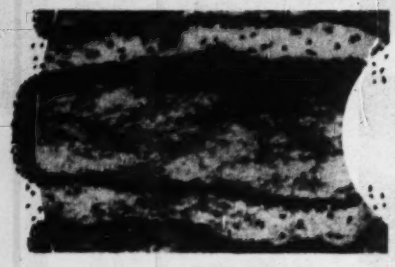
HYATT BEARINGS DIVISION • GENERAL MOTORS CORPORATION • HARRISON, N. J.

GRADUATED DENSITY

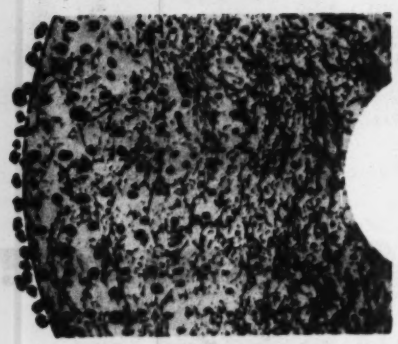
makes MICRO-KLEAN the most effective filter on the market!

How MICRO-KLEAN compares with other cartridge filters

Compare MICRO-KLEAN with FILTERS WITH THE SAME DENSITY THROUGHOUT. The filter media density is the same on the pressure and discharge surfaces of the element; therefore, dirt accumulation is largely on the outside surface, choking the cartridge ("plastering") and reducing the effective filter life.



Compare MICRO-KLEAN with FILTERS WITH HAPHAZARD DISTRIBUTION OF FILTER MEDIA. Uneven haphazard media density permits fluid to find channels through the filter, and pass solids larger than the minimum filter spacing.



Now Look at the advantages offered by MICRO-KLEAN. See how the fibre density increases toward the discharge side of the MICRO-KLEAN filter cartridge? In effect, every Cuno MICRO-KLEAN cartridge is an infinite multiplicity of screens, ranging from relatively coarse on the outside down to 10 microns in the center. Because of MICRO-KLEAN'S graduated density in depth, particles are entrapped within the entire depth of the filter element, giving the cartridge a much longer effective life. Standard cartridge size is 9¾" long by 2¾" O. D., in densities of 10, 25 and 50 microns.

MICRO-KLEAN gives you

- **greater dirt holding capacity**
- **absolute protection against rupturing or channeling of the cartridge**
- **longer effective cartridge life**

REMEMBER . . . IF YOU CAN PUMP IT, CUNO CAN FILTER IT

M.3.C

CUNO ENGINEERED FILTRATION

AUTO-KLEAN (disc-type) • MICRO-KLEAN (fibre cartridge) • FLO-KLEAN (wire-wound)

COMPACT, FULL-FLOW FILTRATION FOR INDUSTRIAL FLUIDS

Fewer Cartridge Changes Necessary with MICRO-KLEAN filters

You don't need a complicated, bulky filter to keep contaminants out of your chemicals, water, lube or fuel oils. Cuno MICRO-KLEAN's compact construction gives you full-flow filtration in space which would limit ordinary filters to by-pass service.

The high porosity and low pressure drop operation of MICRO-KLEAN filters permit this full-flow service on gravity, low pressure, or suction lines—with no loss in operating efficiency.

Cartridge replacement costs are generally cut in half when MICRO-KLEANS are used. MICRO-KLEAN's graduated density-in-depth provides much greater capacity for dirt accumulation within the micronic cartridge, giving twice the useful life of an ordinary filter element.

Cuno's exclusive method of felting fibres produces a cartridge of great structural strength, free from channeling or distortion and entirely unaffected by moisture or acids. And changing cartridges can be accomplished in a few seconds—only one nut has to be removed.

Send for Cuno's free filtration analysis form, have one of your engineers fill it out, and mail it to us. We'll let you know exactly what you need for your filtration requirements—without obligation. And take advantage of Cuno's unique "money-back" offer. If MICRO-KLEAN doesn't outperform any filter cartridge you have previously used, we'll send you *double* your money back. Send the coupon today for free MICRO-KLEAN bulletin.

M.3.5

Cuno Engineering Corporation
Dept. 655C South Vine Street, Meriden, Conn.

I'm interested in your "money-back" offer. Please send me your filtration analysis form—and more information on MICRO-KLEAN for

..... (fluid)

Name.....

Company.....

Address.....

City.....Zone....State.....

Introducing...

FIRST HIGH-SPEED, LOW-COST PROCESS OF COLD FORMING AND WELDING

NON-FERROUS TUBING

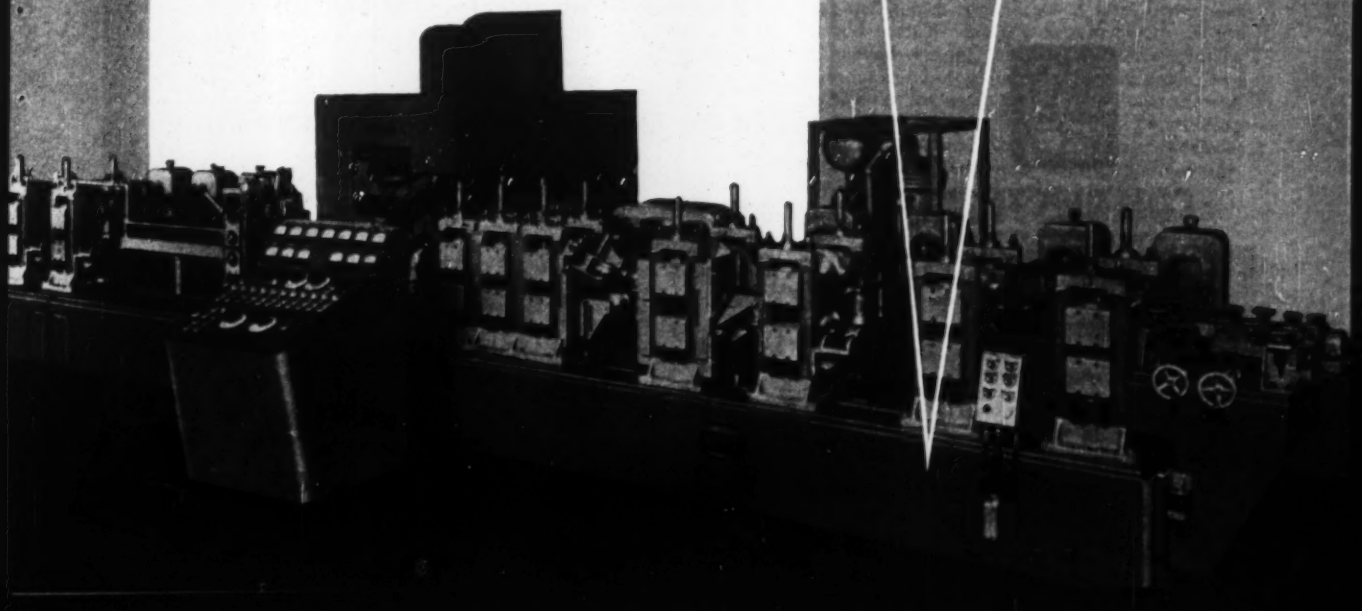
ALUMINUM · MAGNESIUM · NICKEL · BRASS AND OTHER ALLOYS

Speeds range from 30 to 120 fpm, depending on gauge and kind of metal. The process makes possible the conversion into tubing of coiled strip in gauges from 0.156" all the way down to 0.025", *without drawing and annealing*. This means drastic reduction in the cost of making non-ferrous tubing. The lighter the gauge, the greater the saving. Weld strength in many instances exceeds that of the original strength of the metal by as much as 15%.

Thus, for the first time in tube making history, through an exclusive Yoder development, coiled non-ferrous strip can be converted into high grade tubing entirely by cold process, at speeds approximating those employed in making steel tubing by resistance-welding. The story of this epoch-making development makes interesting reading to producers of non-ferrous metals as well as to manufacturers of products incorporating tubular components, both steel and non-ferrous. Send for it!

THE YODER COMPANY • 5499 Walworth Ave., Cleveland 2, Ohio

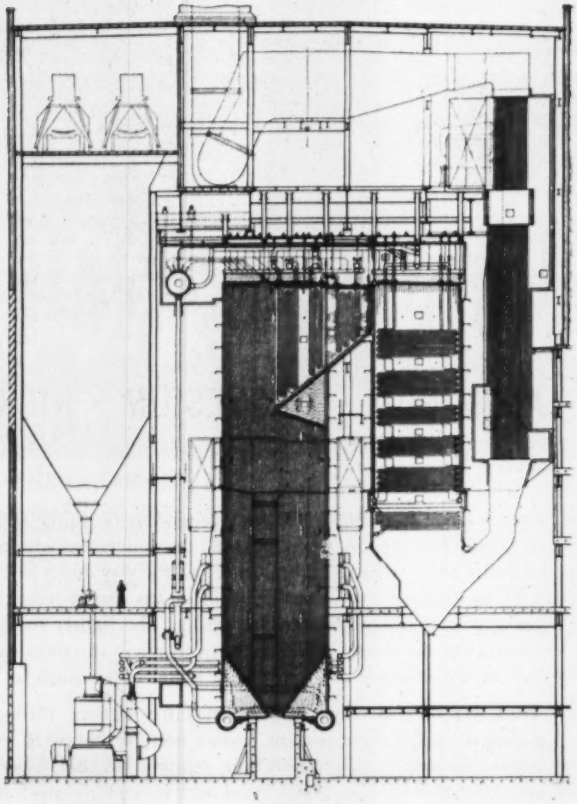
ENGINEERING YODER MANUFACTURING



JOHN C. WEADOCK PLANT

Consumers Power Company

C-E controlled circulation boilers



The C-E Unit shown above is presently in process of fabrication for the John C. Weadock Plant of Consumers Power Company at Essexville, Michigan. Commonwealth Associates, Inc., are the Consulting Engineers.

It is designed to serve a 135,000 kw turbine-generator, operating at a throttle pressure of 2000 psi with a primary steam temperature of 1050 F, reheated to 1000 F.

The unit is of the controlled-circulation, radiant, reheat type with a divided furnace. The reheater surface is located between the primary and secondary superheater sections, and economizer surface is located below the rear superheater section. A tubular type air heater follows the economizer surface.

Pulverized coal firing is employed, using bowl mills and tilting, tangential burners.

B-700

C-E

COMBUSTION ENGINEERING, INC.

Combustion Engineering Building
200 Madison Avenue, New York 16, N. Y.

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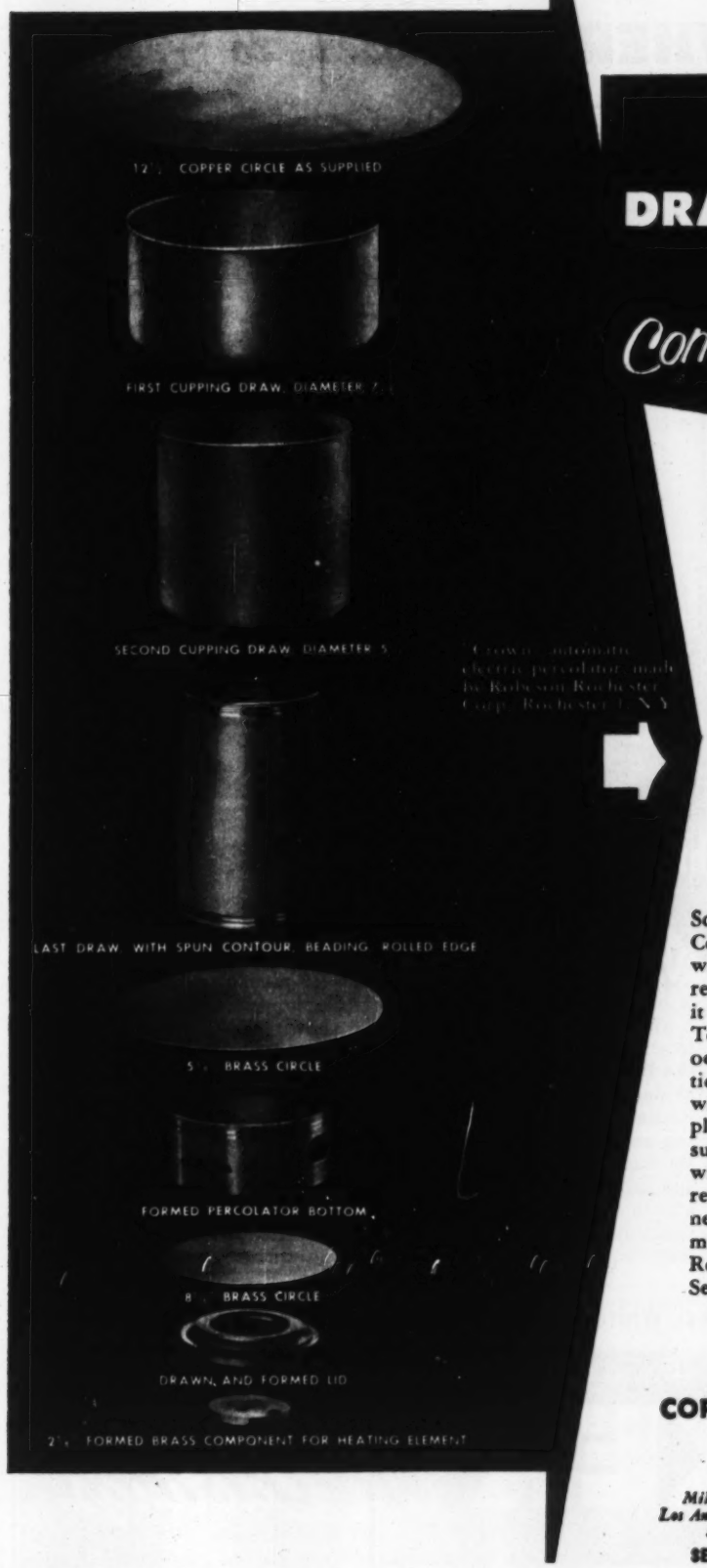
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LAST DRAW WITH SPUN CONTOUR, BEADING, ROLLED EDGE
5" BRASS CIRCLE
FORMED PERCOLATOR BOTTOM
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Consult Revere

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Whether that cost is first or operating, it will pay dividends to investigate the saving possibilities of Rex Chabelco Steel Chain. It has the *extra* strength, *extra* stamina and *extra* quality needed for longer trouble-free operation.

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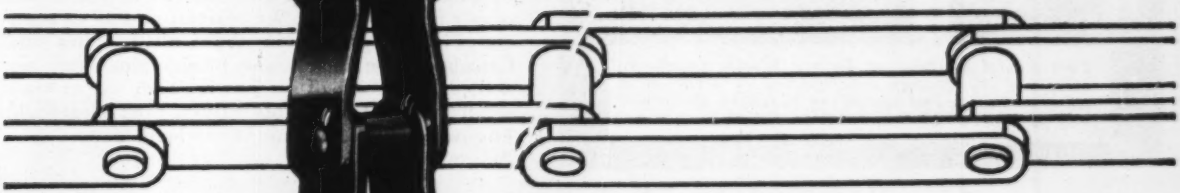
Why not have your Chain Belt District Sales Engineer check your chain requirements with you. He may be able to save you important money—he has for other Design Engineers. Meanwhile, send for Bulletin 53-59. Chain Belt Company, 4765 W. Greenfield Ave., Milwaukee 1, Wisconsin.



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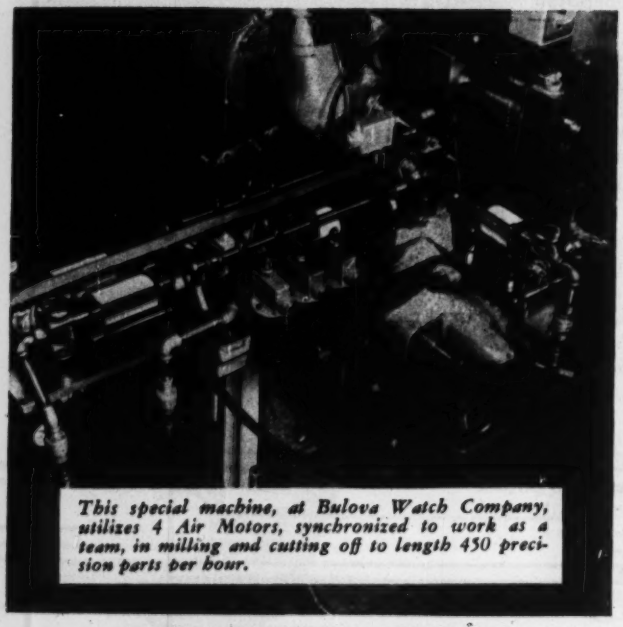

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Your design engineers know the principle and value of "close-coupling-control" used in Bellows Air Motors and Bellows "packaged" pneumatic devices to provide fool-proof electrical interlock of hydraulically controlled pneumatic circuits — but here's what it means in terms of lower cost production in your plant:

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Bellows "packaged" pneumatic devices are complete power units which provide hydraulically controlled air-powered linear motions of unparalleled smoothness at a fraction of the cost of complex cams and gearings. They are easily interlocked electrically with themselves or with other related machine elements.

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In the last twelve years, these versatile units have established amazing records of production accomplishments in thousands of manufacturing plants in all lines of industry. Production gains ranging from 50% to 500% in such operations as drilling, milling, threading, tapping, honing, grinding, lathe turning, etc., are everyday experiences.

Your production executives will be interested in the possible application of Bellows Air Motors and Bellows "packaged" Controlled-Air-Power Devices to your production processes. Write, or have them write, for the new booklet "Faster, Safer, Better Production." Or better yet, have them talk to one of our field engineers. We maintain a staff of some 100 Field Engineers in the United States and Canada. These men know production. They are skilled in the use of air power. They are at your service without cost or obligation. Your local Field Engineer is listed in the phone book under "The Bellows Co." Call him.

If you would like a copy of this new Free Booklet — write Today. Ask for Bulletin CL-50. Address Dept. ME-154, The Bellows Co., Akron, Ohio.

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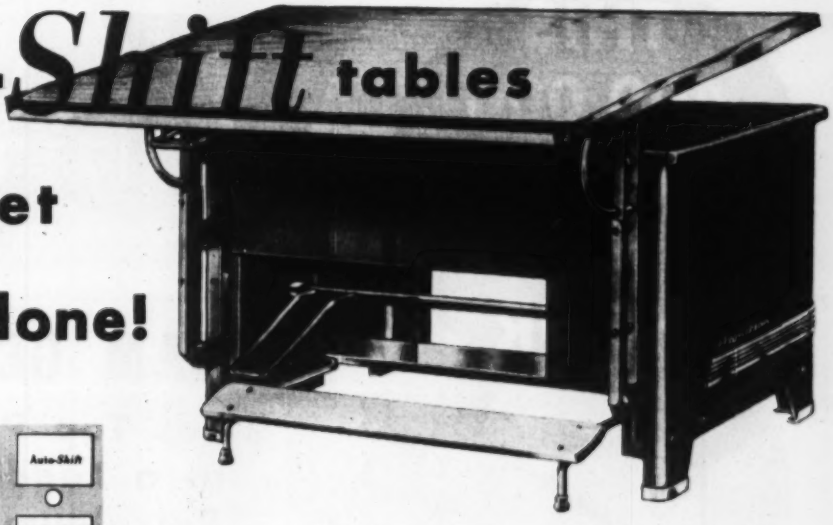
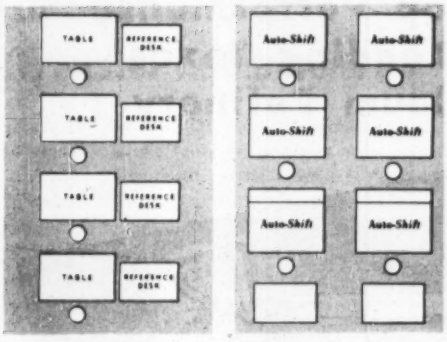
Auto-*Shift* tables help get the work done!



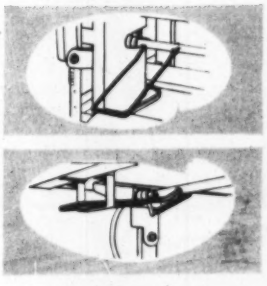


30-50% greater floor space efficiency

Approximately 250 sq. ft. of floor space accommodates *two more* Auto-*Shifts* than board-next-to-desk tables. Space efficiency *and* operating efficiency are greater, since Auto-*Shift* puts large reference surface directly behind each draftsman—instantly, effortlessly accessible.

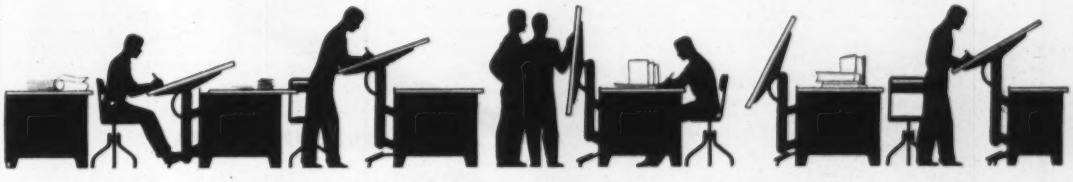
HEIGHT ADJUSTMENT

SLOPE ADJUSTMENT



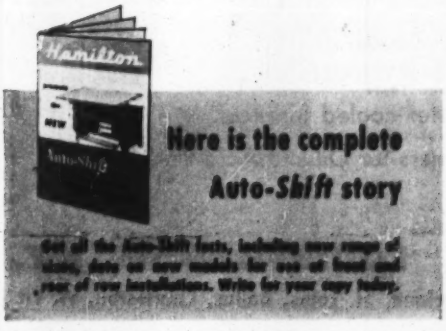
Greatly reduced draftsman fatigue

Auto-*Shift* provides rapid, simple adjustment of both board height and slope—permits draftsmen to change working position frequently. Convenient foot release frees top for height adjustment—hand release permits rapid slope adjustment. Fully counterbalanced top moves effortlessly.



Excels in row installations

Auto-*Shift* efficiency reaches a peak in row installations. Each draftsman has a full-size extension reference surface directly behind him, generous drawer space immediately at hand. Everything is where he needs it to work quickly and accurately. Auto-*Shift* helps get the work done!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Auto-Shift
Here is the complete Auto-Shift story
Get all the Auto-Shift facts, including new range of sizes, data on new models for use at front and rear of row installations. Write for your copy today.

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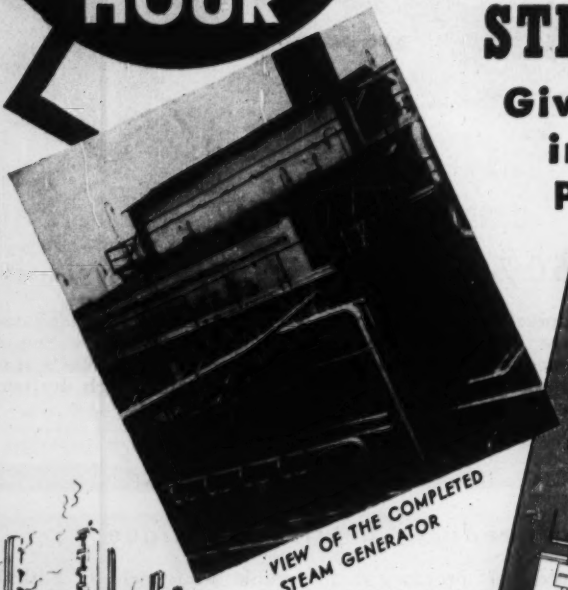
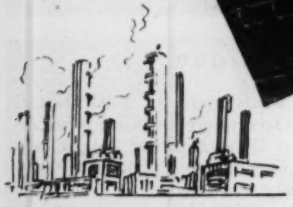
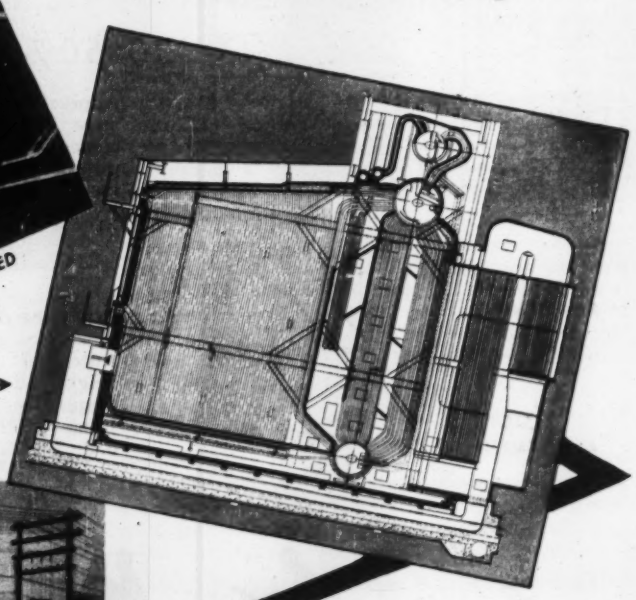


VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT → LONGITUDINAL SECTION THROUGH THE UNIT.



6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

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400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Oil and Acid Sludge fuel.

Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

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JET APPARATUS • HEAT TRANSFER EQUIPMENT • STRAINERS • CONDENSERS AND VACUUM PUMPS • OIL BURNING EQUIPMENT • ROTAMETERS • FLOW INDICATORS • RADIAFIN TUBES • VALVES • SPRAY NOZZLES AND ATOMIZERS • GEAR PUMPS • DESUPERHEATERS

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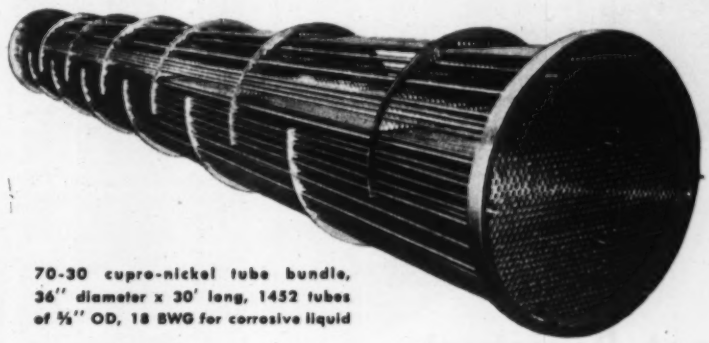
Have you, or are you likely to have, a problem in Heat Transfer involving *special* heavy duty equipment? Does your problem involve out-of-the-ordinary materials, highest precision and uniformity requirements, better than ordinary test and quality control facilities? Would you like to have technical assistance from HT specialists with wide experience?

Or do you just need a well designed, carefully built standard Heat Transfer Unit?

SK manufactures standard equipment, designs and builds special equipment for heat transfer service for pressures up to 5000 psi, temperatures to 1100° F.

And, *here's why* you should come to SK for such equipment—

All SK Heat Transfer Units feature: (1) close tolerances between tube OD and tube sheet hole ID; (2) polished tube ends to insure best metal to metal joint between tube OD and tube hole; (3) shell bores to exact tolerances to insure close fitting baffles for top efficiency; (4) rigid inspection of materials, methods, final assembly; (5) A.S.M.E. Code qualifications; and (6) electronically controlled tube expansion*. SK is particularly well equipped to solve unusual HT requirements, because . . .



70-30 cupro-nickel tube bundle, 36" diameter x 30' long, 1452 tubes of ¾" OD, 18 BWG for corrosive liquid

SK has specialized in HT problem solving for a great many years—is set-up operationally for this.

The engineering staff is experienced—includes Chemical, Industrial, and Mechanical Engineers who *understand* chemical, power, processing, marine requirements, who *think* on the level you will require, who *talk* your language.

SK research facilities are set up to *anticipate* future requirements.

Production facilities are such that the company has been able to provide radiafin air coolers rated at 7500 hp weighing 47,000 lbs. . . . heat exchangers with special Everdur tube bundles, shells and head lining . . . 36" diameter, 30' long cupro-nickel units for cooling sodium carbonate solution for liquid rheostats . . . special units for handling hydrocarbon gases and synthetic rubber.

Quality Control and test facilities include equipment for hydrostatic, magnaflux, pneumatic, temperature shock, polariscope testing and radiographic inspection (250,000 Volt X-ray machine; Cobalt 60).

Space will not permit many other details worth noting but, if you want more information, do this: (1) write for Bulletin HT-1 which describes the type equipment we make, or (2) request a copy of Vol. 5 No. 3 Engineering News which contains an article on our problem-solving facilities.

*Tubes being expanded using electronically controlled tube rolling machine. This method provides advantages as follows: (1) every tube is expanded uniformly with no over or under expansion, (2) there is no enlargement of tube holes, (3) ligament fracture is prevented, (4) there is minimum tube elongation and tube sheet warpage is reduced, (5) tube wall stresses are reduced, (6) guess work is eliminated, ideal standards for tube joints apply.

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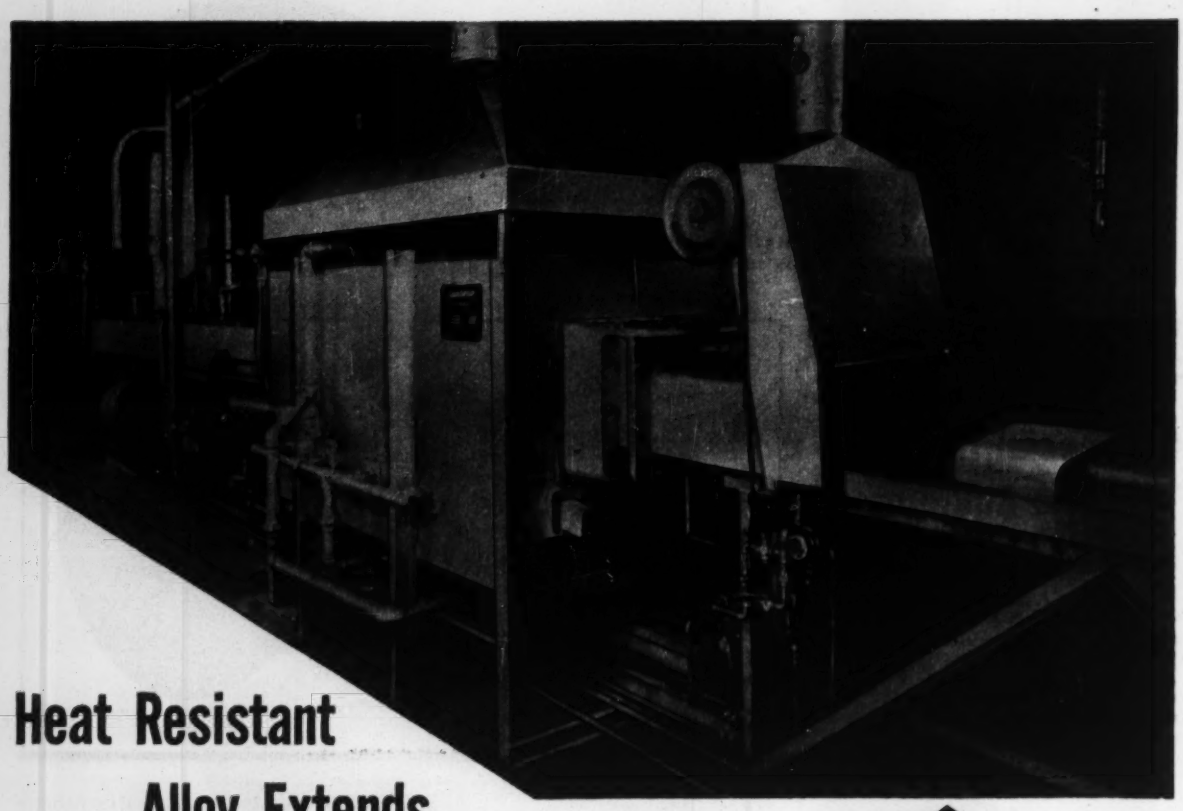

Heat Resistant Alloy Extends Equipment Life

Still good after 14 years

The muffle of this annealing furnace has withstood continuous alternate heating and cooling since 1940, except for a shut-down period during the Korean war.

Still in use 14 years after installation, this casting... produced in 35% nickel-18% chromium heat resistant alloy... demonstrates the economy of using nickel alloyed material to resist growth, warping, scaling and other deteriorating effects of heat.

From among the many engineering alloys containing nickel, you can select a material to provide the best set of properties for meeting one or a combination of requirements.

Let us help you find practical solutions to your metal problems. Make use of our counsel and data based on years of specialized experience in the fabrication, treatment, properties and performance of alloys containing nickel. Send us details of your problems for our suggestions.

Original Muffle ...cast in a 35% nickel-18% chromium heat resistant alloy, trade-named "Chromax," and produced at the Harrison, N. J., plant of Driver-Harris Company... still serves after 14 years in this gas fired, controlled atmosphere, pusher-type furnace manufactured by Sunbeam Corporation, Industrial Furnace Division, Chicago 23, Ill.

Heat Resistant nickel-chromium alloy is also used for the annealing furnace conveyor.

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THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

MECHANICAL ENGINEERING

Published by The American Society of Mechanical Engineers

VOLUME 76 NUMBER 1

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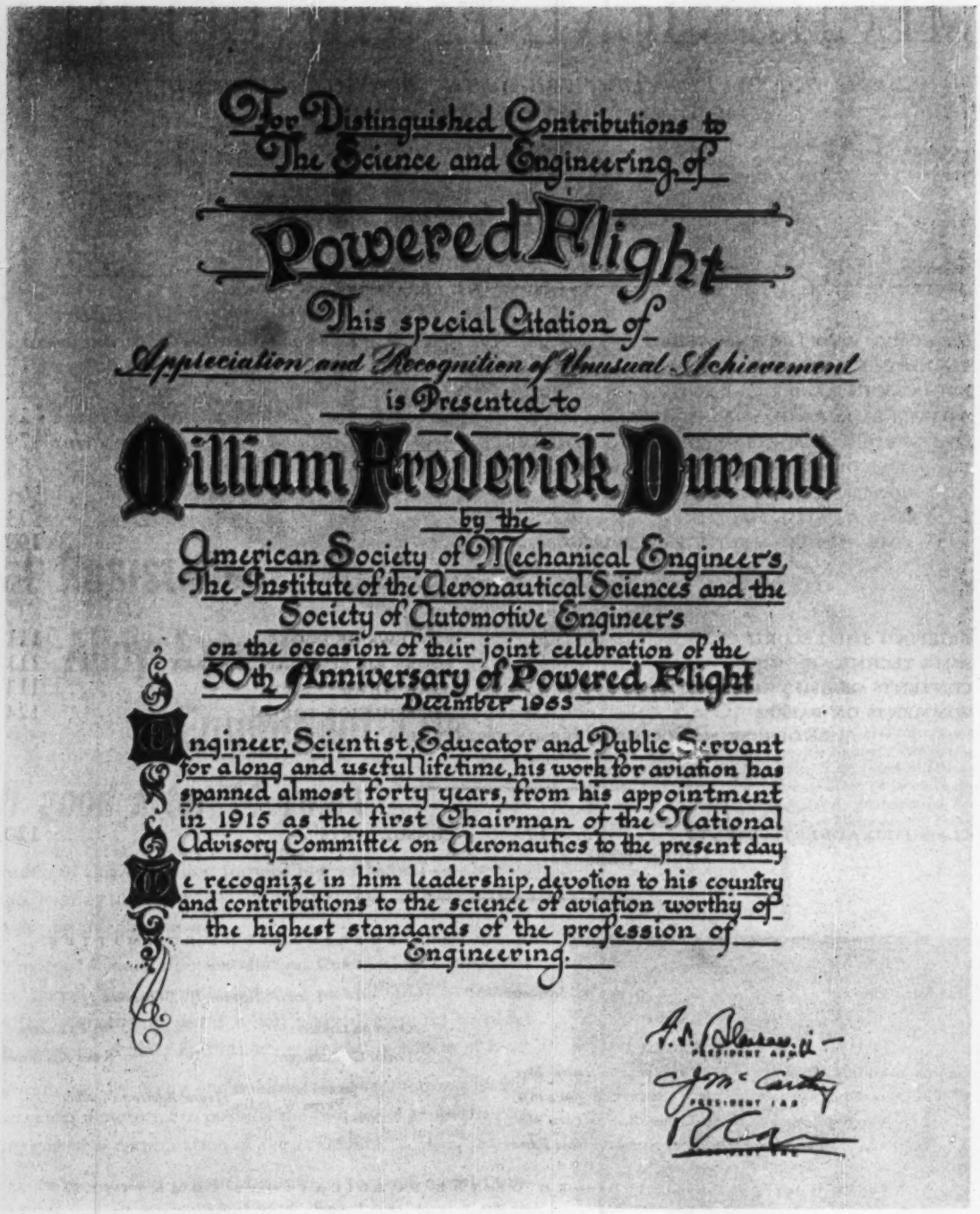

For Distinguished Contributions to
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Powered Flight

This special Citation of
Appreciation and Recognition of Unusual Achievement
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William Frederick Durand

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The Institute of the Aeronautical Sciences and the
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on the occasion of their joint celebration of the
50th Anniversary of Powered Flight
December 1953

Engineer, Scientist, Educator and Public Servant for a long and useful lifetime, his work for aviation has spanned almost forty years, from his appointment in 1915 as the first Chairman of the National Advisory Committee on Aeronautics to the present day.

We recognize in him leadership, devotion to his country and contributions to the science of aviation worthy of the highest standards of the profession of Engineering.

Facsimile of Scroll Presented to Dr. W. F. Durand, Honorary Member and Past-President of the ASME

(*See Aviation Luncheon, pages 83 and 84 of this issue.*)

HELP WANTED—

for Community Service

By THOMAS E. MILLSOP

PRESIDENT, WEIRTON STEEL COMPANY, AND MAYOR OF CITY OF WEIRTON, WEST VA.

THE title, "Help Wanted—for Community Service," sounds very much like the heading of a classified advertisement in the daily newspaper. To my knowledge, it is an advertisement that has never appeared in the classified section of any newspaper and probably never will. But it does appear every day on the front page and the other news pages of every newspaper. It is an advertisement that is implicit in practically every story of a constructive community activity—because there is hardly a community activity that does not need the help of more people and of people with more to contribute. And by contribution I do not mean financial aid—important as that may be—but personal service. That same advertisement was implicit in both the writings and the personal example of Dr. Wright.

HELP WANTED BY CITY GOVERNMENT

I believe I can safely say that it has been many years since any man in my audience has read the help-wanted columns of his newspaper. You have jobs and, as a result, aren't particularly interested in these columns. For this and other reasons, I'm afraid that most business and professional men—engineers included—have failed to take notice of the help-wanted pleas of their city governments. Nevertheless, there is a voice calling out for this type of service—a voice that we too seldom heed for the same reason we don't ordinarily read the classified advertisements . . . we already have jobs.

My reason for addressing this Society is that I answered the advertisement and I will tell about some of the penalties and the rewards.

It is this need for volunteers for community service that I want to discuss. Understand that I am not talking in particular about service in the state or Federal Government. My remarks are concerned with Main Street, but the same principles and obligations of life along Main Street hold true right up to the President's cabinet.

Those who make a study of human relations tell us that man, to live a full, worthwhile, and happy life, must have a well-rounded interest in many activities. The reverse is also true, that the extent and type of a man's activities will govern the kind of life he lives. It is common knowledge that the man who enjoys success, happiness, and a deep sense of accomplishment is the man whose life is well balanced. In other words—man cannot live by bread alone. Or, if you would care to alter that to fit this occasion, let us say that the engineer cannot live by the slide rule alone.

Today, a man must be more than just skilled in a profession or business. He must be a good citizen, and to accomplish this he must be in contact with society, taking his place where he is needed and can best benefit the community, the state and the nation.

I am reminded of the remark of Sir Winston Churchill during the Festival of Britain in London in the summer of 1951. He was taken up to a telescope in the Dome of Discovery and was told that there he could view the outer spaces. He looked through the telescope, and then remarked: "Take me down. I am more interested in what is happening on earth."

Sir Winston put his finger on a fault which too many of us have. All too often we spend our time stargazing, permitting our minds to wander so many light-years away that we aren't conscious of the wonderful every-day life going on around us. The point I seek to make is—we cannot shut ourselves off from the rest of life simply by pursuing a single occupation, because the complexities of our civilization require that man play a many-sided role. It is not enough for him to be a good engineer, doctor, lawyer, clergyman, farmer, or steelmaker. By virtue of the very fact that he is a human being, he must accept the realization that the true value of his existence will be measured not only on how well he has served humanity through his work, but also on how well he has served humanity as a human being.

ONE MAN'S EXPERIENCE IN COMMUNITY SERVICE

My experience in community service has been gained in my home town—Weirton, West Virginia. In most ways Weirton resembles the average American community; in some ways it is quite different. And so that you may have a background of what I will say about community service, I am going to tell you briefly about the origin and development of Weirton.

The city is located on the Ohio River in the upper panhandle of West Virginia. The population is about 30,000. The community was founded in 1909, when Ernest T. Weir, now Chairman of National Steel Corporation, stood on a hilltop and said: "Here we will build a steel plant." His purpose was to place an industry in a new community based on harmony and the golden rule, where men could live together and work together in peace. How well he succeeded is borne out by the fact that the Weirton Steel Company and the people of Weirton have not had a single minute of lost time due to labor strife in more than 20 years.

When Mr. Weir and his associates started the Weirton mills, they, of course, also started the community. At first, twenty-five homes were built, then fifty more. Streets were laid out, then schools, churches, stores, and everything else that goes to make up a city followed as the mills expanded. Finally, in the Weirton Valley there were three incorporated areas—Holliday's Cove, Marland Heights, and Weirton Heights—and the largest unincorporated town in West Virginia—Weirton.

In 1946, the various service, fraternal, patriotic, and social organizations in the area each named a representative and these people formed the Community Service Council, a body that sat down and planned for the community's future. Their first project was to incorporate all of the communities into one city named Weirton, and at a special election in 1947 the people approved the idea.

In the six years that have gone by since that incorporation, the community has shown greater progress, I believe, than any other city of equal size. We have made vast improvements in

The Roy V. Wright Lecture, delivered at the Annual Meeting, New York, N. Y., December 2, 1953, of The American Society of Mechanical Engineers.

our water, lighting, sewage, and street-building systems. In addition to setting up a city government that has operated in the black since its inception, we have been able to build and expand in other ways. Eighteen months ago we opened a million-dollar Community Center for the youth of our community; just last August 14, we dedicated a $3,750,000 hospital which is one of the most modern in the country; on November 9 we opened a new Vocational High School and dedicated a new elementary school in December. New home construction is running better than $4,000,000 per year. Within a short time, every street in our city will be paved, and for a city of our size I believe this is rather unusual. These are just a few of the things we have been able to accomplish, because civic pride and a spirit of co-operation prevail among our citizens.

MAKING A CITY GOOD TO LIVE AND WORK IN

Weirton Steel men serve on the City Council, aid in the Community Chest and Red Cross campaigns, and help with the city's building projects. They weren't ordered to do these things or told to work with the Boy Scouts, the Girl Scouts, churches, civic clubs, public schools, or a dozen other civic enterprises I could mention. They do what they do because they want to keep Weirton a friendly place to work and a good place to live.

My big experience with community service began back at the time of our city's incorporation in 1947. The citizens who had formed the Community Service Council came to me and asked if I would be a candidate for mayor in that first election which was held after the incorporation.

As I have mentioned, incorporation was number one on the list of improvements of the Community Service Council. Some of the other projects on their original list—now all accomplished—were: construction of the Community Center and the Hospital; improvement of school facilities, a new highway leading north to the Lincoln Highway, new housing, a white way, enlarged quarters for the public library and beautification of the city. And at present, there are many other things on which we are at work for the continuing improvement of Weirton.

Now, I think most people will agree that running a steel plant is a full-time job, and I was just a bit reluctant back in 1947 to leave myself wide open to the responsibilities and headaches which would come if I should run for mayor and be elected. But then I considered that the people of the community who had come to me and asked me to be a candidate were faced with similar obligations. Many were mill men from our plants and from other industries in Weirton. Some of them were business men and professional people, and clergymen and clubwomen, and some were mothers who had families to take care of. Many were young people. Yet, all of them were unselfishly willing to devote their time in an attempt to make our community a better place in which to live. They wanted to get the new city off to a sound start and had decided that the best way to do this would be under the leadership of someone who had no political ambitions and no desire for personal gain.

I had reasons for not wanting to take the job. Since our company is the major industry in Weirton, I was known as "the boss" to many citizens. I saw that if I became mayor I would be in a double capacity and in a sense forced to lead a double life. It was a situation in which I would be "the boss" from eight to five o'clock in my office at the Weirton Steel Company, but at the same time—if I were mayor—the people would be my boss. There was the strong possibility that the responsibility of one position might militate against that of the other.

However, the community leaders were sincerely convinced that I should offer myself for the job, and I realized that I would be shirking my duty as a citizien if I didn't accept. So I agreed to run, making it clear that I would not campaign—that I would want to be mayor only on the condition that the people of Weirton wanted me on the basis of my record as a steel-company president and a citizen.

I was in Germany on a special mission for the War Department and General Eisenhower when I was nominated in 1947. I made no speeches in the general election campaign either. My fellow citizens carried my campaign forward to victory. I can honestly say that for me it was the beginning of a wonderful and gratifying experience. Right now I'm in the middle of my second four-year term. As I look at Weirton today I am proud that I have been privileged to have a part in its sound development. The sense of accomplishment that I feel is without a doubt the best recommendation that I could give for taking part in community affairs.

I can warn you from experience, however, that your motives in community service will often be misunderstood. You might do an outstanding job, and just when you believe that a bit of credit or a pat on the back might be coming your way, you get hit with a "brickbat." You can't please all of the people all of the time, and how well I know it. The important point is, however, for all of us to do the best we can, with what we've got, where we are!

All around us in America today, I see tangible evidence of what the engineer does and can do. I see it in our buildings, our bridges, and our factories throughout the length and breadth of the land.

I see evidence, too, of the great work of engineers in the steel industry as I look at the plants of Weirton Steel Company and National Steel Corporation. Here, the men of our engineering departments have designed some of the safest, fastest, and most efficient steel-producing facilities in the world.

When this nation was extending its military might on the global fronts during World War II, Weirton received a desperate call from Army Ordnance for 8-in. howitzer shells. The military people were quite amazed when we told them that delivery could begin months before they expected it. We delivered ahead of time as we promised, largely because of labor-management teamwork and because our engineers were competent and always seemed to be able to do the impossible. They proved it again when we were called upon to produce a still-secret product for the first atom bomb. We succeeded after others had failed. Our conversion from the production of war-time materials after World War II was another triumph of engineering know-how.

Today these same Weirton engineers have also had the initiative to go out into the community, away from their slide rules and drawing boards, and render civic service that has been extremely beneficial not to only the city, but to the state and nation as well. Some of them are members of school boards, giving those organizations the benefit of their training. Others are active in the P.T.A. groups, working in the best interests of the children of the community. Most of them are active in the churches of their choice. These are just a few of the many activities in which our engineers—and our other employees—are engaged, in addition to their regular daily work, but I believe this brief mention serves to convey the idea that there are innumerable civic outlets for any man's energies.

WHY CONCERN OURSELVES WITH POLITICS?

Roy V. Wright exemplified the best in civic tradition when he determined that he not only must play his part, but also must encourage and inspire other engineers to follow his example. Yet, while we expound our theories on the subject or discuss our practical experiences that certainly have borne fruit, there will be those who will ask "Why should we concern ourselves with politics when there are professional politicians to do the job?" Our answer must be in the example we set.

The past century has brought a complete change in our way of life, thanks to America's freedom of opportunity and its men of ingenuity. The frontiers disappeared—were rolled away, if you please, on the wheels of a machine age. Men like Fulton, McCormick, Whitney, Edison, the Wright brothers, Ford, and hundreds of others made their contributions to a growing and expanding country. Industries mushroomed, railroads spanned the continent, ocean liners came into being, and man flew across the skies.

We are all familiar with the enveloping change that has taken place. Today, you can step into an airliner at Idlewild Airport and 14 hours later you're in Paris. Next year the British are going to fly jet airliners across the Atlantic in five hours. Because of the difference in time, this means that you can have breakfast in London at 8 o'clock, fly to New York, and arrive here at 8 o'clock the same morning in time for a second breakfast.

The net result of the evolution we have experienced is a fired-up civilization. We live in one world—a shrinking world at that. Although it is true that our new horizons stretch beyond the city limits of your town and mine, there is still important work to be done at the community level of government.

It matters little whether a man devotes his talents to a building or expansion program, to the school system, to the Scouts or the fire departments, just so long as he recognizes that there is a need for him and that, through his training and experience, he will give the community the benefit of his services.

ENGINEERING RANKS SHRINKING

Today there is an acute shortage of engineers in America, and the outlook is for a continuing shortage in the years that lie ahead. Since the first machines ushered in the Industrial Revolution, the engineer has been both the mainspring and the balance wheel in the great clock upon which our progress has been recorded. That clock has ticked away the years, and today it finds the engineer playing still another role—that of maintenance man. He is still the initiator and tempering force for progress, but his added duty requires that he provide the maintenance for the civilization that his work has built.

We in industry have been requested to tell the youth of our communities that between 35,000 and 45,000 engineers are currently needed for industry and civilian-government activities, while thousands more are needed as teachers to prepare future engineers. It is alarming that while the pressure for more production is growing, the number of trained men for relieving it is decreasing.

We also are attempting to show young men and women that this need for engineers will continue after the world is at peace. Then there will be new frontiers for the engineer and scientist to explore—frontiers in space, in transportation and time, in agriculture, in all of the known and many undiscovered phases of our life, including the development of atomic power for useful purposes in a peace-time economy.

I don't think there is any doubt in anyone's mind that the engineer shortage must be overcome if our standard of living is to be maintained.

And I sincerely believe that it can be overcome if the members of the engineering profession will follow the example of Dr. Wright and Henry Laurence Gantt. The problem is, as I understand it, to sell the future of engineering, as it would be said in politics, at the "grass roots" level. It must be sold in the homes and high schools of your communities.

SETTING AN EXAMPLE

This is one approach and my own idea of it. Engineers can increase the desire of young people to enter the profession by setting the right examples, by being looked up to and respected in their own communities. We are all aware that hero worship is a part of growing up. An outstanding play on the football field or a new personality on the screen at the neighborhood theater will carry our teenagers off on waves of enthusiasm. In the same manner, you can gain the respect of the young folks through "starring" in community affairs. By becoming a well-known and active community worker, you not only attract attention to the project on which you are working, but you also bring a degree of recognition to your profession. It is not improbable that as a tangible result many youngsters will want to follow in your footsteps as a good citizen and also as an engineer.

SHORTAGE OF SCIENCE TEACHERS A PROBLEM

If you are looking for a specific outlet where your community responsibility can be used, let me suggest that, as engineers, you might want to give our high schools some attention. All of them need help—and immediate help.

From 1950 to 1953, there was a 38 per cent decrease in the number of young men and women preparing for careers in high-school teaching. This was the average, but among those young people preparing for science teaching, there was a 49 per cent drop. And these figures give us a good indication of why there is an increasing shortage of engineers.

Most young people decide upon their careers while they are in junior high school at fourteen or fifteen years of age. If there are no teachers to interest them in science they will naturally turn to other fields. And because of a teacher shortage, an alarming number of high schools no longer give science courses.

How does your community fare on this point? You know that unless a high-school student has mathematics, physics, and the other science courses, he is automatically shut out of a career in engineering. So one of the main gaps in the supply of engineers which are so necessary to our economy can be found right in our own home towns—in the high-school classrooms.

We can help improve this by becoming interested in and active in the high-school programs. One way in which industry can help is to offer part-time or summer employment to teachers so they can supplement their inadequate incomes. While this will give the teachers added incentive to stay in the schools, it also will give them an opportunity to view at first hand the problems, needs, and accomplishments of industry.

HELP WHERE IT'S NEEDED

When you return to your own "Main Street" look about your community critically. Don't wait for someone to ask you to serve. Find what jobs need to be done or need to be done better than now. Select the one or ones that interest you most and to which you can give most effective service—then volunteer.

Sometimes national and world problems, because of their enormity and complexities, seem insoluble, but community problems are close enough and manageable enough for all of us to do something about them. Next to the home, the community with its various institutions is the unit which most affects our day-by-day lives. If we help to build strong and prosperous communities, we are helping to build a strong and prosperous nation.

Do not misunderstand me—this acceptance of community responsibility is not suggested for members of the engineering profession alone. I respectfully recommend that it is an obligation which should be respected by men and women of every profession, every business, every walk of life. It is an exacting obligation that should be accepted in good faith, a faith which will permit a man to step up to the door of his community when the sign "*Help Wanted—For Community Service*" is posted, and say—"I will take that job."

FIG. 1 15-TON, 36-IN., 3-WAY, UNIVERSAL BROACHING MACHINE

(Built by the American Broach and Machine Company, Ann Arbor, Mich. This machine was used in the surface-broaching research study made on titanium.)

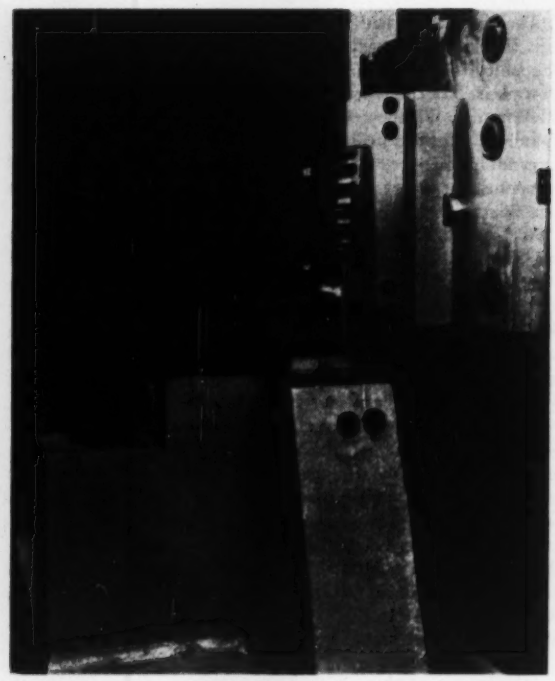

FIG. 2 SPECIAL TOOL, TOOLHOLDER, AND CAST-IRON FIXTURE USED IN SURFACE-BROACHING TESTS

(The 2-in. cubical block of work material is located by set screws and is clamped by a swing clamp. Position of workpiece in relation to cutting tool is established by ground shim stock.)

Developing a TEST *for* BROACHING TITANIUM *and Its* ALLOYS

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A SURVEY made of manufacturing plants, broach manufacturing processes, and literature indicated that short tool life was encountered when broaching titanium alloys with high-speed-steel tools of standard design. A project to study broach design and operating conditions was instigated as part of the project "Machinability of Titanium" sponsored by the U. S. Army Ordnance through Watertown Arsenal with the work being carried on in the Production Engineering Department of the University of Michigan.

In order to evaluate broach performance it was first necessary to develop a test procedure and criteria for measuring the effectiveness of broaching. A surface-broaching operation was chosen, so that tool angles and size of cut could be controlled accurately and the resulting tool wear and surface finish easily measured.

[1] Associate Professor, Production Engineering Department.

[2] Professor, Production Engineering Department. Mem. ASME.

Contributed by the Research Committee on Metal Processing and co-sponsored by the Production Engineering Division and presented at the Fall Meeting, Rochester, N. Y., October 5–7, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

EQUIPMENT

These surface-broaching studies were pursued on a 15-ton 36-in., 3-way universal broaching machine, Fig. 1, furnished by the American Broach and Machine Company of Ann Arbor. That company also provided the necessary floor space in its plant to carry out these tests.

The cutting tool, toolholder, and work fixture, which were designed for the broaching operation, are shown in Fig. 2. The heavy cast-iron fixture held a 2-in. cube of work material by means of a swing-type holddown clamp and setscrews. Shims behind the work material gave adjustment for metal removal per cut.

The broaching tools were ground from hardened, "Circle C" high-speed steel in the form of 1 in. × 1 in. × 3 in. long bits having a Rockwell hardness of 64–66 C. All broaching cutters were form-ground to a 6-tooth 2-pitch cutter shape as shown in Fig. 3. The relief angles, rake angles, and rise per tooth were varied during the first part of these tests. The cutter B was taken as the "standard" and was ground according to the

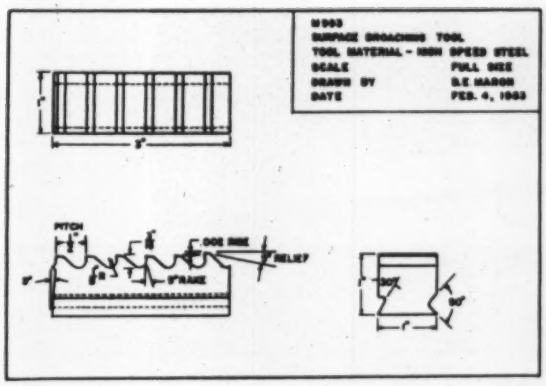

FIG. 3 STANDARD TOOL DESIGN USED IN SURFACE BROACHING
(Variations in rake, relief, and rise per tooth were investigated.)

results of preliminary tests and recommendations[3] of the Broaching Tool Institute. The cutter B with 5 deg rake, 5 deg relief, and 0.002 in. rise per tooth varies in the recommendations of relief and rake from normal surface-broaching practice because of the poor surface finish encountered when using the smaller relief angle of $^1/_2$ or 2 deg and the reduced tool life resulting from larger rake angles. The cutters which were tested are listed in Table 1.

TABLE 1 BROACHING CUTTERS TESTED

Cutter	Rake angle, deg	Relief angle, deg	Rise per tooth, in.
A	5	5	0.005
B	5	5	0.002
C	5	2	0.002
D	5	$^1/_2$	0.002
E	20	5	0.002

The materials cut in this investigation are listed in Table 2 and were pure titanium Ti-75A, and the alloys, Ti-150A, Ti-150B, and RC-130B. The SAE 1045 steel was used for comparison. All of these materials were shaped to 2-in. cubes before testing.

[3] "Broaches and Broaching," by W. W. Burden, published by the Broaching Tool Institute, 1944.

CUTTING-FORCE DETERMINATION

The cutting-force variation and magnitude were determined by installing a Control Engineering Corporation Model EP-3000 pressure pickup in the hydraulic system of the broaching machine. A Sanborn single-channel recorder, Fig. 4, measured the instantaneous pressures during the broaching cycle to give comparisons of materials cut, and broach design.

A typical record of pressures during a test of consistent performance on SAE 1045 steel is shown in Fig. 5. The lowest line on the chart is the machine idling pressure. At the start of the downward motion of the ram the pressure is increased to overcome the back pressure on the head of the machine. The irregular trace shows the sequence of each of the six teeth entering the cut. The net pressure was the difference between the maximum gross pressure and the tare pressure. The top chart in Fig. 5 was for the beginning of the test, the middle chart after 75 cuts, and the bottom chart at 150 cuts. The attenuator setting on the recorder was set at 4× giving a value of 20 psi per small space for this record. The net force includes the additional friction force on the ways of the machine caused by the cutting force and is therefore slightly higher than would be expected from dynamometer tests.

The unit power, hp/cu in. per min, which is the energy per unit volume of material cut and a measure of cutting efficiency was computed from the formula

$$\text{uhp} = \text{unit horsepower} = \frac{\text{Horsepower, net}}{\text{Cu in. of metal removed per min}}$$

$$= \frac{FV}{33{,}000 \times 12 fwn}$$

where F = maximum net force, lb
V = cutting speed, fpm
f = rise per tooth, in.
w = width of cut, in.
n = maximum number of broaching teeth in contact = 4

The unit-power values are slightly higher than for conventional cutting because the chips rub in the chip space, and because of the added friction in the ways of the broaching machine.

"Surface roughness" in microinches, rms, was measured by traversing across the work perpendicular to the direction of cutting using a profilometer shown in Fig. 4. Tool wear and

TABLE 2 PROPERTIES OF MATERIALS CUT

Materials	Composition (per cent of elements)	Yield strength psi	Tensile strength, psi	Per cent elongation, in 2 in.	Per cent reduction of area	Bhn
Ti-75A	Commercially pure titanium	58300	82000	28	47	217
Ti-150A	Cr 2.7, Fe 1.3, O 0.25, N 0.02, C 0.02, Ti Bal	131400	140500	25	55	302
Ti-150B	Cr 5, Fe 5, Mo 5, Ti Bal	150000	151800	14	16	311
RC-130B	Mn 4, Al 4, Ti Bal	139300	155200	18	42	331
SAE 1045 steel	C 0.45, Si 0.27, Mn 0.70, P 0.02, S 0.02	50100	101700	21.9	34	201

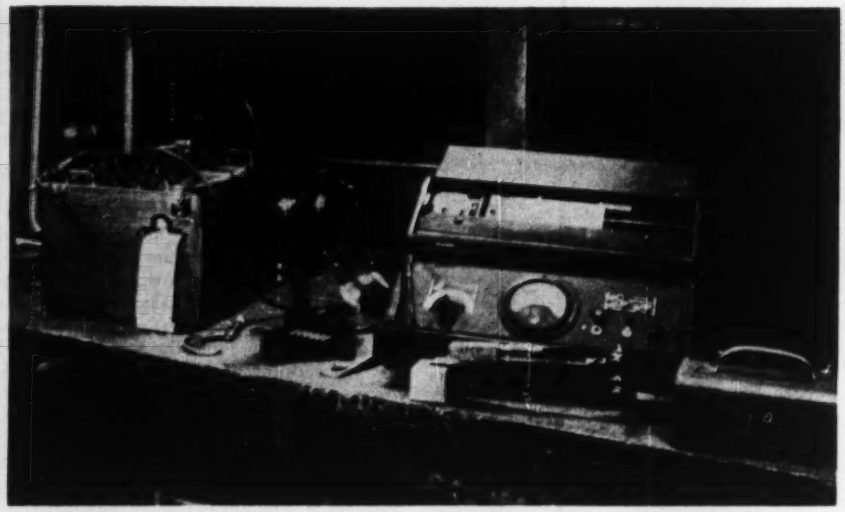

FIG. 4 SANBORN SINGLE-CHANNEL RECORDER OSCILLOGRAPH AT LEFT, USED IN RECORDING PRESSURE VARIATIONS IN HYDRAULIC SYSTEM OF BROACHING MACHINE; A BINOCULAR MICROSCOPE USED IN MEASURING TOOL WEAR; AND A PROFILOMETER AT THE RIGHT FOR MEASURING SURFACE ROUGHNESS OF WORKPIECE

metal seizure at various stages were measured using a binocular microscope with a filar micrometer eyepiece.

TEST PROCEDURE

The standard test for each material was established as 150 cuts with periodic inspection of the cutting tool and the surface finish on the work. Inspections were made after the first, fifth, tenth, twentieth, and every ten cuts thereafter. No cutting fluid was used. During each test the net pressure was recorded with the Sanborn recorder as shown in Fig. 5. The cutting force was computed by multiplying the net pressure by the piston area. The back pressure on the piston was kept constant at all times to preload the piston and give a steady rate of cutting. All tests were run 150 cuts or until the cutting force increased sharply indicating dulled cutting edges as shown in Figs. 5 and 8. The cutting speed was 20 fpm.

The chip formation was observed, and sample chips were

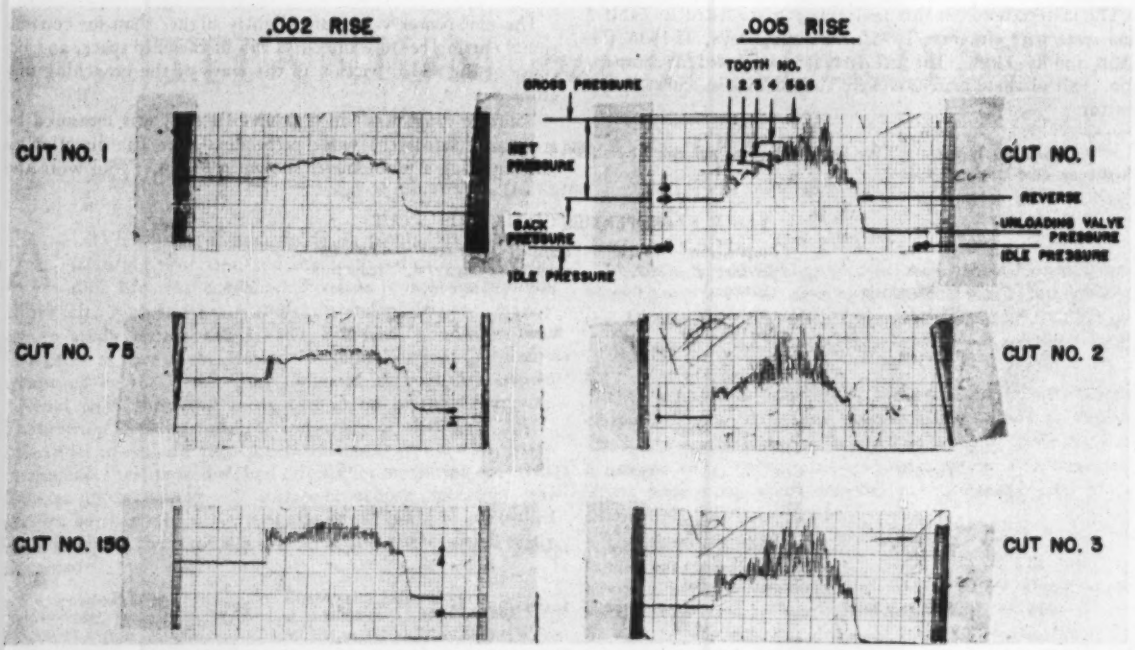

FIG. 5 SAMPLE POWER CHARTS TAKEN FROM SANBORN RECORDER FOR EACH OF TWO RISE INCREMENTS, 0.002 IN. AND 0.005 IN. (Indicated value of net cutting pressure was used in determining maximum cutting force on broaching tool.)

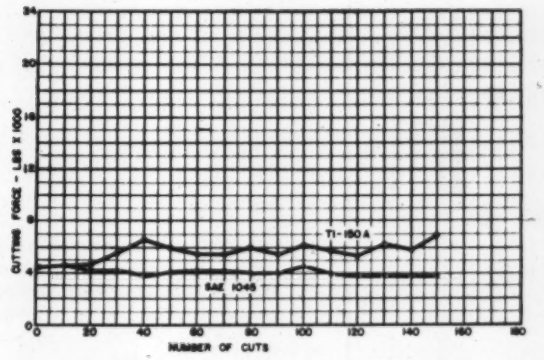

FIG. 6 COMPARISON OF CUTTING FORCE FOR TI-150A WITH SAE 1045 STEEL, USING HSS TOOL OF 5 DEG RELIEF, 5 DEG RAKE, AND DRY-CUT CONDITION; 0.002 IN. RISE PER TOOTH

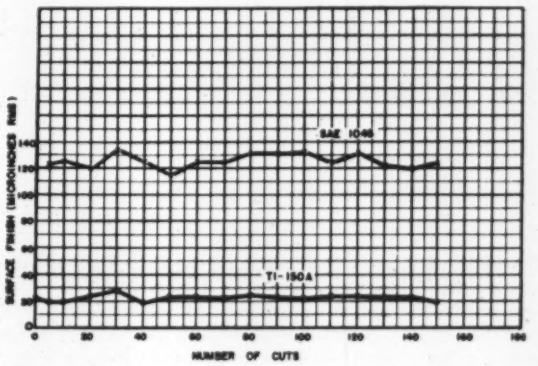

FIG. 7 COMPARISON OF SURFACE ROUGHNESS OF SAE 1045 STEEL AND TI-150A WHEN BROACHING WITH STANDARD HSS TOOL OF 5 DEG RELIEF, 5 DEG RAKE, DRY-CUT CONDITION, AND 0.002 IN. RISE PER TOOTH

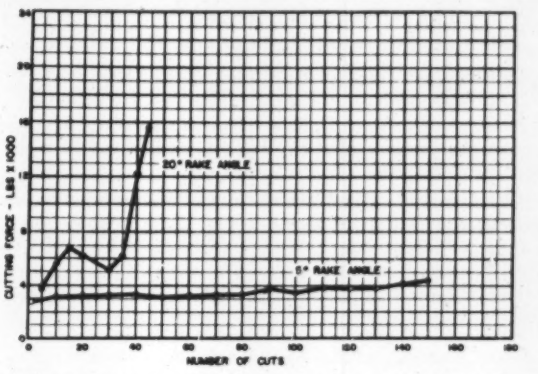

FIG. 8 EFFECT OF RAKE ANGLE ON CUTTING FORCE OF A 1-IN-WIDE BROACHING CUT IN TI-75A, USING A STANDARD HSS TOOL OF 5 DEG RELIEF, UNDER DRY-CUT CONDITION; 0.002 IN. RISE PER TOOTH

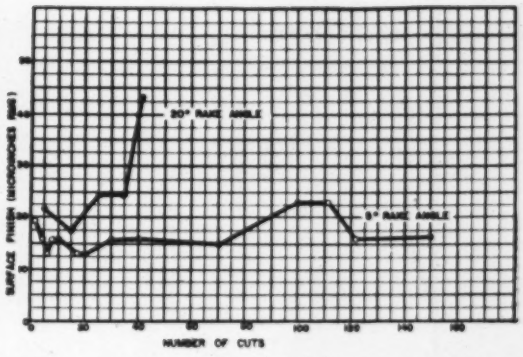

FIG. 9 EFFECT OF RAKE ANGLE ON RESULTING SURFACE FINISH, WHEN BROACHING TI-75A WITH STANDARD HSS TOOL OF 5 DEG RELIEF, UNDER DRY-CUT CONDITION; 0.002 IN. RISE PER TOOTH

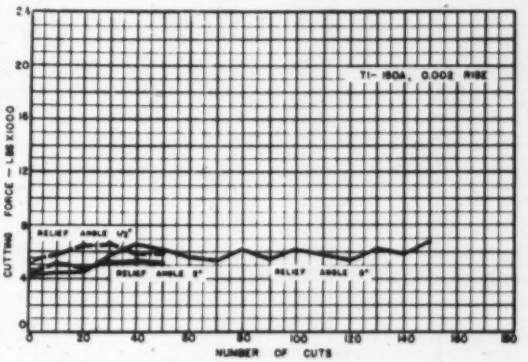

FIG. 10 COMPARISON OF CUTTING FORCES DEVELOPED WITH STANDARD HSS TOOLS OF VARYING RELIEF ANGLES, WHEN BROACHING TI-150A
(Rake angle was 5 deg on tool.)

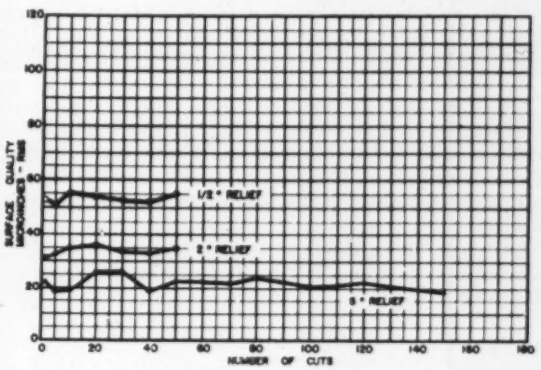

FIG. 11 EFFECT OF RELIEF ANGLE OF SURFACE-BROACHING TOOL ON SURFACE QUALITY OF WORKPIECE WHEN SURFACE BROACHING TI-150A
(Tools were ground with 5 deg rake; 0.002 in. rise per tooth.)

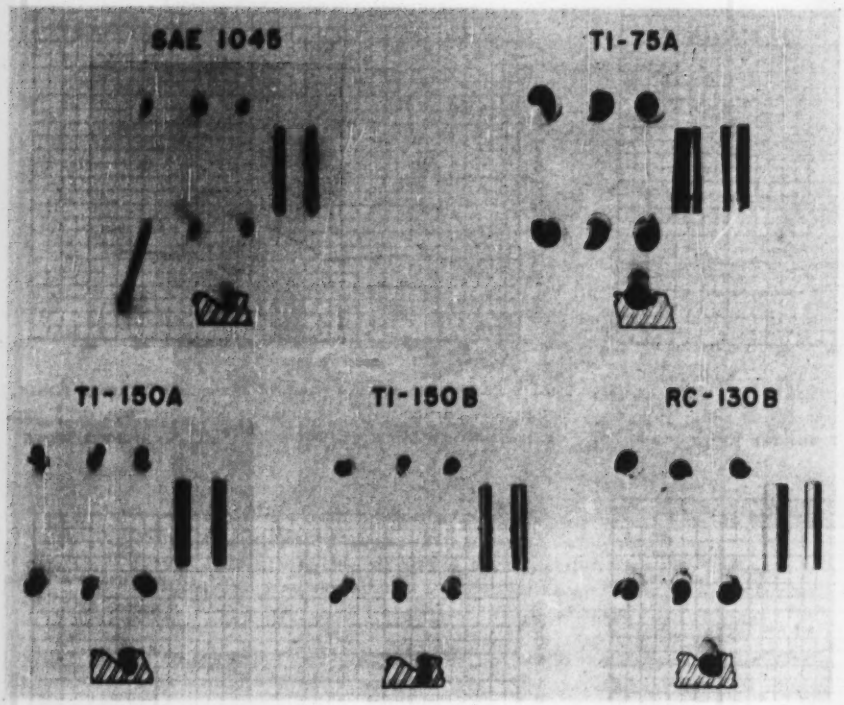

FIG. 12 TYPES OF CHIPS FORMED ON VARIOUS MATERIALS, WHEN SURFACE BROACHING WITH STANDARD HSS TOOL OF 5 DEG RAKE AND 5 DEG RELIEF; 0.002 IN. RISE PER TOOTH

measured for thickness to compute the ratio of chip thickness to original feed, and the shear angle at the point of chip flow.

RESULTS OF TESTS

Typical Tests. Titanium, Ti-150A, has a more rapid rate of wear and consequently a more rapid increase in force than SAE 1045 steel as shown in Fig. 6 when using cutter B with 0.002 in. rise per tooth. At the start of the broaching test both materials required a cutting force of 4300 lb. However, after 150 cuts the cutting force for SAE 1045 steel had dropped to 3800 lb while the cutting force for Ti-150A had increased to 6900 lb. This increase in force is partially due to pickup or seizure on the land of the broach under the cutting edge. This pickup was heavy after 40 cuts and was first mistaken for wear. It later decreased and the cutting force also decreased.

The surface finish for titanium Ti-150A is vastly superior to the SAE 1045 steel as shown in Fig. 7, where surface finish ratings of 19–28 μ rms were found for Ti-150A as compared to 115–135 μ for the SAE 1045 steel. The thin chip and smaller, more uniform, built-up edge accounted for the good finish for titanium.

Rake Angle. Rake angles of 5 and 20 deg, tools B and E, were tested by broaching Ti-75A using 0.002 in. rise per tooth. The results of the tests, presented in Figs. 8 and 9, show that the broach with 20 deg rake failed after 44 cuts while the 5-deg-rake broach did not fail after 150 cuts. Failure of the 20-deg-rake broach was indicated by a sharp increase in power as shown in Fig. 8, and by a rougher surface finish as in Fig. 9. Further tests using 0.005 in. rise per tooth gave only 18 cuts for the 20-deg-rake broach while the 5-deg-rake cutter completed 150 cuts in good condition. The 20-deg-rake cutter also would dig in, pulling the work or the tools from their holders. The 5 deg rake was used for all subsequent tests.

Relief Angle. Relief angles of $^1/_2$, 2, and 5 deg were tested when broaching Ti-150A. Small relief angles caused scoring or seizure on the lands of the teeth resulting in a slight increase in cutting force, Fig. 10, but a definite deterioration of the surface finish as indicated in Fig. 11. The $^1/_2$ deg relief produced a surface roughness of 52–55 μ rms as compared to the satisfactory performance of the 5 deg rake which gave a surface finish of 18–26 μ rms.

Chip Formation. The types of chips formed when broaching the various materials are shown in Fig. 12 for 0.002-in. rise per tooth, and in Fig. 13 for 0.005 in. rise per tooth using broaches with 5 deg rake and 5 deg relief. The insert sketches illustrate the provision for ample chip space between the cutting teeth.

TABLE 3 CHIP THICKNESS AND SHEAR ANGLE—RAKE ANGLE, 5 DEG—RELIEF ANGLE, 5 DEG

	0.002 In. rise			0.005 In. rise		
Material cut	Chip thickness, in.	Thickness ratio	Shear angle, deg	Chip thickness, in.	Thickness ratio	Shear angle, deg
SAE 1045	0.0040	0.500	27.5	0.017	0.294	16.7
Ti-75A	0.0052	0.385	21.5	0.011	0.455	25
Ti-150A	0.0050	0.400	22.5	0.007	0.714	37
Ti-150B	0.0045	0.445	24.7	0.008	0.625	33
RC-130B	0.0085	0.235	13.5	0.008	0.625	33

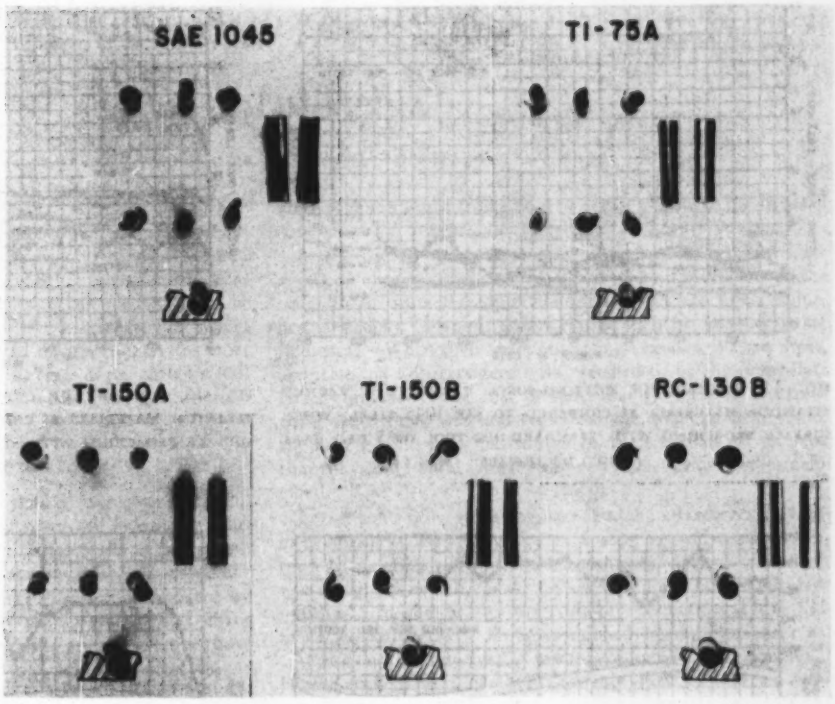

FIG. 13 TYPES OF CHIPS FORMED ON VARIOUS MATERIALS, WHEN SURFACE BROACHING WITH STANDARD HSS TOOL OF 5 DEG RAKE AND 5 DEG RELIEF; 0.005-IN-RISE PER TOOTH

All of the chips were of the spiral continuous type except Ti-75A at 0.002 rise per tooth which was a more open type.

Chip thickness was measured with a toolmaker's microscope and the shear angles computed as shown in Table 3. When using 0.002 inch rise per tooth all the titanium chips were thicker than the steel chips, whereas with the 0.005-in. rise per tooth the titanium chips were thinner than the steel chips. This would indicate that lighter feeds of 0.002 inch would cause less unit pressure on the face of the tool than the heavier feeds. The calculated shear angles for titanium also show normal values for the 0.002 inch rise per tooth but high shear angles for the 0.005 inch rise per tooth.

Materials Cut. Figs. 14 to 17, inclusive, show for each of the materials the composite curves of cutting force and surface finish plotted versus the number of cuts. The variables are:

Fig. 14, cutting force—0.002-in. rise, 5 deg rake, 5 deg relief
Fig. 15, surface finish—0.002-in. rise, 5 deg rake, 5 deg relief
Fig. 16, cutting force—0.005-in. rise, 5 deg rake, 5 deg relief
Fig. 17, surface finish—0.005-in. rise, 5 deg rake, 5 deg relief

All the materials shown in Fig. 14 survived 150 cuts at 0.002 in. rise per tooth. Ti-75A compares favorably with SAE 1045 steel in the magnitude of cutting force, but the slope of the Ti-75A curve is steeper than that of the latter, showing a greater wear rate on the cutting tool or a greater degree of smear.

Ti-150A, Ti-150B, and RC-130B are quite similar in cutting-force characteristics at the 0.002 in. rise, showing a range of values from 4000 to 7200 lb cutting force.

Fig. 15 shows a good surface finish with all of the titanium materials, the entire range covering 6 to 28 microinches, rms, as compared to SAE 1045 steel at 115 to 135 microinches, rms. The RC-130B had an especially good surface finish with an average of 10 microinches rms for 150 cuts at 0.002 in. rise per tooth.

The cutting forces for each of the materials at 0.005 in. rise per tooth are shown in Fig. 16. Ti-150B offered such great resistance to penetration at 0.005 in. rise that the test was discontinued at the end of three cuts. RC-130B had lower cutting-force values than any of the materials and SAE 1045 was highest during the first part of the test with approximately 10,700 lb during the first 80 cuts.

Surface finish in microinches rms is plotted versus number of cuts for the 0.005-in-rise per tooth test shown on Fig. 17. SAE 1045 steel started at 100 μ surface finish and increased to 143 μ at the end of 150 cuts. Ti-75A and RC-130B show a range of 8–14 μ for the 150 cuts—results that are exceptional for a 0.005 in. rise on a surface-broaching tool.

Summary Table 4 shows the values of unit horsepower (horsepower/cubic inch per minute), cutting force in pounds

SUMMARY TABLE 4 RESULTS OF SURFACE-BROACHING TESTS ON VARIOUS TITANIUM MATERIALS AS COMPARED TO SAE 1045 STEEL USING A STANDARD 1-IN-WIDE, HSS TOOL OF 5 DEG RAKE AND 5 DEG RELIEF UNDER DRY-CUT CONDITION

(Cutting speed, 20 fpm.)

Material	Tool rise per tooth	Unit hp	Cutting force, lb avg for 150 cuts	Surface finish range for 150 cuts
SAE 1045	0.002	1.29	4090	115 –135
	0.005	1.30	10360	100 –150
Ti-75 A	0.002	1.20	3820	13 – 23
	0.005	1.14	9080	10.5– 14
Ti-150 A	0.002	1.81	5750	19 – 28
	0.005	1.30	10300	32.5– 50
Ti-150 B	0.002	1.82	5780	11.5– 13.5
	0.005	1.87	14820[a]	37[b]
RC-130 B	0.002	1.64	5190	6 11
	0.005	1.02	8120	7.5– 14.5

[a] Three cuts only.
[b] First cut.

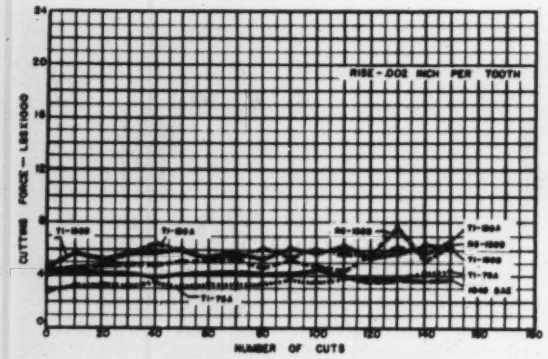

FIG. 14 SUMMARY OF CUTTING-FORCE CURVES FOR VARIOUS TITANIUM MATERIALS AS COMPARED TO SAE 1045 STEEL, WHEN SURFACE BROACHING WITH STANDARD HSS TOOL OF 5 DEG RAKE AND 5 DEG RELIEF

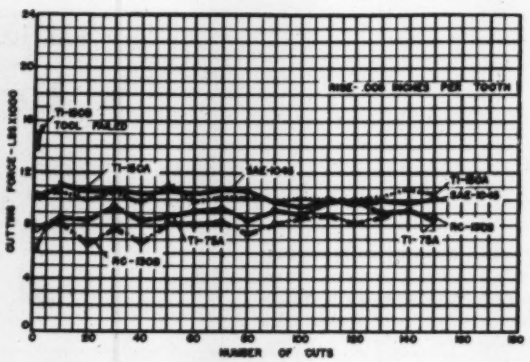

FIG. 16 SUMMARY OF CUTTING-FORCE CURVES FOR VARIOUS TITANIUM MATERIALS AS COMPARED TO SAE 1045 STEEL, WHEN SURFACE BROACHING WITH STANDARD HSS TOOL OF 5 DEG RAKE AND 5 DEG RELIEF

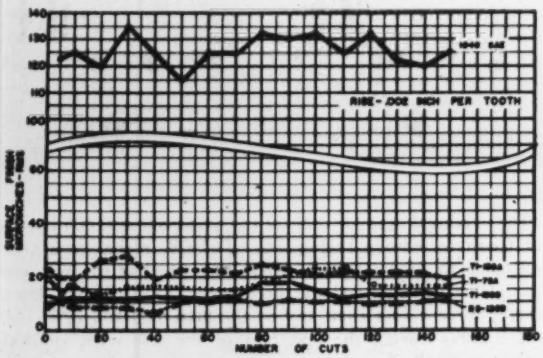

FIG. 15 SUMMARY CURVES SHOWING RESULTING SURFACE ROUGHNESS ON VARIOUS MATERIALS WHEN SURFACE BROACHING WITH STANDARD HSS TOOL OF 5 DEG RAKE AND 5 DEG RELIEF

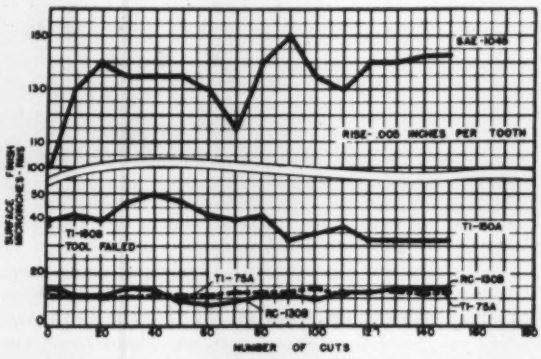

FIG. 17 SUMMARY CURVES SHOWING RESULTING SURFACE ROUGHNESS ON VARIOUS MATERIALS WHEN SURFACE BROACHING WITH STANDARD HSS TOOL OF 5 DEG RAKE AND 5 DEG RELIEF

and surface finish in microinches rms for each of the materials. The values of unit horsepower and cutting force are averages and the surface-finish values indicate a range of measurements obtained during the standard test of 150 cuts. The unit-horsepower values are slightly higher than those normally expected from free chip flow across a tool face, because of additional frictional losses. These values normally indicate cutting efficiency but, in the case of broaching, a net machine efficiency. A rating of the materials on the unit-horsepower basis gives preference to Ti-75A with SAE 1045 steel, RC-130B, Ti-150A, and Ti-150 B in descending order.

The RC-130B gave outstanding results in surface finish at both 0.002 in. and 0.005 in. rise per tooth. The values are 6–11 microinches rms for the former and 7.5–14.5 for the latter. All of the titanium materials are better than SAE 1045 steel in surface finish owing to the size of the built-up edge on the steel cutting tool.

CONCLUSIONS

1 This type of surface-broaching test, using cutting forces, surface finish, and tool wear to determine tool life, appears to be a satisfactory index to broaching machinability.

2 Relief angles for broaching titanium should be increased above those normally recommended for ductile materials. An angle of 5 deg proved quite satisfactory.

3 Rake angles should be reduced below those normally recommended for broaching ductile materials because of the tendency for the tool to dig in. A 5-deg rake angle proved better than 20 deg.

4 Chip formation seems to present no problem in the packing of the chip space provided recommended practice is used.

5 A rise per tooth of 0.002 or 0.005 in. gave reasonable performance in all cases except when broaching Ti-150B at 0.005 in. rise. Chip-thickness measurements indicated that 0.002 in. rise per tooth produced better pressure distribution on the tooth face.

6 Superior surface finishes were obtained for the RC-130B at both the 0.002 and 0.005 in. rise per tooth. All of the titanium materials gave excellent surface finish as compared to steel.

7 Unit-horsepower values for titanium materials are comparable to steel.

ACKNOWLEDGMENT

Grateful acknowledgment is given for the support of the Watertown Arsenal and the encouragement of its laboratory personnel in carrying out this work.

ECONOMICS *and the* ENGINEER

By PHILIP M. McKENNA

PRESIDENT, KENNAMETAL, INC., LATROBE, PA. MEMBER ASME

WHAT I have to say about present-day economics and the engineer will, I believe, be given the same level-headed treatment that we must give to processes and machines to accomplish our daily work. Then as practical men we shall do something about it. Our occupations, our liberties, and our very lives are in jeopardy until we correct prevalent fallacies that have operated in this country for more than 20 years in regard to money. The lives of our children will be even more affected with disaster if we do not eradicate these fallacies and soon.

ECONOMICS HAS DEFINITE LAWS

Mechanical engineering requires that we agree on such concepts as mass, force, distance, horsepower, kilowatts, modulus of elasticity, and the like, and define the standard units in which we measure them. Economics, and more particularly, monetary economics, has definite laws; they have been discovered by painful experience and careful observation over a period of five thousand years. Lack of knowledge and appreciation of those laws can wreck the machinery of our modern society in the hands of uninformed leaders, just as surely as deliberate violations of these laws have wrecked both ancient and modern civilization. I appeal to you to apply an ancient time-tested empirical science, one that few have the time and patience to study. If people generally do not grasp the elementary facts which monetary science teaches, the results may be as disastrous as if the knowledge of volts and amperes were to be ignored in the daily use of equally complicated and dangerous electrical machinery of modern life.

Anyone who exhibits lack of knowledge of ordinary laws of physics is thrown out of our councils as untrustworthy. If a fellow in our shop talks about increasing the power of a lathe by putting in some gears to increase the horsepower, we recognize that he doesn't know the difference between pounds of force and horsepower. Consequently, his chatter is disregarded as that of an ignoramus in that field. But when people, often high in political and even business and academic life, give out opinions on economics, and more particularly on monetary economics, displaying lack of fundamental knowledge, or deliberate intellectual dishonesty in those fields, unfortunately they are often listened to gravely without being given a horse-laugh or even a skeptical smile. The "money illusion" can play tricks for a while, but is no more sound than a collection of gears to make a perpetual-motion machine.

Did you ever ask an inexperienced metal worker to flatten out a sheet of brass in which there was a bulge at one spot? The natural thing to do in an attempt to restore the desired flatness is to put the sheet on an anvil and hit the place that sticks up. But as metalworkers know, that only stretches the metal there and by reasons of geometry the thinner metal takes up more area and has to accommodate itself by arching up all the more. The man who knows what he is doing straightens the sheet by gently stretching areas all around the bulge, wisely refraining from hammering the place where the trouble seems to be. Likewise, in economic affairs a man who knows what to do to relieve specific trouble doesn't take a blow at the isolated conditions but studies how to relieve the whole situation.

In the past 20 years numerous economic dislocations have appeared as a consequence of ignoring by the public of the necessity for a sound medium of exchange and standard of value, determined by economic forces rather than by pressure-group influences. When there were not enough houses in some areas, artificial and arbitrary rent fixing seemed to be the immediate remedy against rising cost of space but that led to waste of what space there was and paralyzed the financial strength of the very people who had shown by their actions in the past that they could build sufficient houses to meet the economic demand.

In our fields of work as engineers and manufacturers, government planners, scrapping the profit motive and competition, resorted to renegotiation and excess-profits taxes. The effect was to cut the muscles of the horses that did the more effective pulling. "Excess-profits tax" might better stand for "efficiency-penalty tax!" Profit is defined in my dictionary as: "Accession of good; useful results; desirable consequences." How can there be an excess of desirable consequences in a competitive society? I have been told that political considerations required that acknowledgedly vicious tax.

To govern a people, a tyrannical government must demand sacrifices of the people. You must have emergencies, they say. Hitler expressed that idea, saying that the people were like a woman, not to be treated rationally. The English proverb, "a woman, a dog and a walnut tree, the more you beat 'em the better they be," is an expression of that idea. Do businessmen work better under punitive taxation? What would you think of a man who, when a gasoline engine wouldn't start, took to hammering it with a sledge hammer in anger? Having taken out three of the four spark plugs of a four-cylinder engine, by a 75 per cent rate of tax upon efficient concerns, the machine of free enterprise limps badly.

Your Towne Lecturer in 1947, Mr. C. E. Wilson of General Motors Corporation, mentioned the narrower definition of profit as "excess of returns over expenditure." In justice to the Honorable Mr. Wilson, it should be pointed out that he goes on to say this is only part of the definition because it "ignores the dynamic role that industrial profits play in the economy." But Mr. Wilson did not point out that the standard of value must be defined and fixed, if bookkeeping in dollars is to represent a true condition. For this purpose the gold standard throughout all history seems to have been the best time-tested standard.

WHY SHOULD ENGINEERS BE CONCERNED WITH ECONOMICS?

Why should we engineers concern ourselves with economics and more particularly with monetary economics? It is because we live and work in a field where economic considerations govern intelligent action. Without a standard of value by which to compute the desirability of one course of action compared to other possible courses the engineer is without guide or compass. It's as if the chemist were to be deprived of his balance, or the mechanic were to be deprived of his measuring scales. Is one particular process, tool, or machine preferable to another? How do we decide? We do so by trial and error and assess the

The Towne Lecture delivered at the Annual Meeting, New York, N. Y., December 1, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

results by economic considerations. We total up the man-hours of work, at the rates of pay to which the capacities of free workers entitle them, we add the other costs, such as electric power, fuel, lubricant supplies, and materials used in each of the several processes to be compared. That sum is expressed in units of a common denominator, called the dollar in the United States. The products are compared in their values, expressed likewise in dollars. The length of life of the machines or other capital equipment required for each process is compared and the costs for replacement of the equipment when it becomes useless, by wearing out or by obsolescence, are all expressed in dollars. To those of us who have to deal with evaluation of risks the mathematics of probabilities must also be applied.

WHAT HAPPENS WHEN STANDARDS OF VALUE CHANGE?

What happens, when as at present, the standard of value—the yardstick or measure of all wealth—is uncertain and for 20 years has been steadily deteriorating, having lost about half its purchasing power in the United States in the past 10 years and 90 per cent or more in many nations abroad? And moreover, because of steeply graduated income taxes, one dollar earned by one person or concern is not equivalent to a dollar earned by another person or concern because variable percentages of that dollar are taken away in income taxes? We mechanical engineers have all had experiences where we can show that a machine will pay for itself in five years in shop costs, but when earnings from the use of that machine are taxed at 70 per cent, the management must take into consideration that it will require $16^2/_3$ years to pay for the machine in 30-cent dollars retained after taxes. The equation then becomes affected by the laws of chance. What are the chances that taxes will be lowered during the period of useful life? Will excess-profits taxes be in effect during the years of useful life? What will be the most likely value of the dollar when the machine is worn out and another must be bought to replace it? If it is likely that the dollar will buy only half as much after $16^2/_3$ years, one must reckon on 33 years to repay the value needed to replace the machine; and if the folly be compounded by the dollar deteriorating to one fourth its value in 33 years, earnings must be four times as much as would have been the case with a stable dollar.

Conversely, if distrust of the results of the continuation of the present domestic policy of politically managed credit and irredeemable paper currency prevails and produces economic distortions, paralysis, and possible stagnation, the machine may be bought secondhand later for a few cents on the dollar. Strange as it may seem to those who have not studied the history of paper money, bad times occur when people lack the confidence engendered by the gold-coin standard. Good times are not ensured by a plethora of money and credit.

As economists say, you cannot push on a string. You can lead a horse to water but you can't make him drink, say some; but others add that you can hold his head under water until he drowns of liquidity.

The longest period of depression in the United States was from 1873 to 1879, when the threat of "greenbacks" prevailed among businessmen. It was dispelled in 1879, when we resumed gold payments under John Sherman. In our own experience, since we were taken off the gold standard to try a "liberal" experiment in 1933, there were 13 consecutive years of budgetary deficits. Did that period encourage the activities of free men? No, on the contrary, between August, 1937, and March, 1938, the stock-market index dropped nearly 50 per cent and from May, 1937, to May, 1938, industrial production dropped nearly 33 per cent in one of the sharpest declines in any 12-month period in our history. Commodity prices, on the eve of our participation in World War II, (i.e., November, 1941), were only 92.5 per cent of 1926 prices. This was despite the 41 per cent devaluation of the dollar in 1934. This devaluation laid a base for our present great depreciation in the purchasing power of your dollar which in March, 1951, reached the lowest level in our history since 1914.

There is no valid basis for the widespread belief that irredeemable paper currency produces stability. The average number of unemployed in each year from 1934 to 1939, inclusive, never was less than 7,700,000 (in 1937) and even as late as 1939, the unemployment was still 9,500,000. Failure of more substantial recovery to occur for such a long period had not happened since the somewhat similar experience in 1873 to 1879. Only the harsh remedy of war obscured those telltale lines on the charts of objective economists recording the failure of the paper-money plan in peacetime conditions to reduce unemployment permanently and substantially.

Confused by all this, management and, more importantly, the investigators they represent, either refrain from making investments or wishfully gamble upon "something turning up" to improve their conditions. Gambling becomes a habit instead of sensible computation of calculated risks in business; unproductive gambling becomes a national abomination in countries undergoing monetary inflation. Meanwhile, only a few wise and honest men devote themselves to the fundamental necessity of re-establishing a sound currency before we come to the end of the road—total repudiation of all money and fixed investments. The French chemist, Lavoisier, Pierre Dupont, Condorcet, Desmeuniers, and others having knowledge of the fallacies of irredeemable currency, advised against the assignat of the French Revolution, even though based upon land taken from the Church ostensibly as security.

A MONEY CALCULUS REQUIRED

Among us are engineers whose work is to protect the country in time of war. To them may I point out that efficiency of production and choice of what we should do requires a money calculus. To destroy a large animal it is only necessary to strike his nerve center, his brain, with a bullet, whereupon the creature no longer co-ordinates the actions of his organs and muscles. He then falls sprawling to the ground aimlessly twitching until he dies. As Karl Marx and Frederick Engels preached in 1848, to destroy a complicated civilized society it is only necessary to paralyze the nerve centers by which it co-ordinates its economic activities, namely, its monetary standard and its free markets. France has been suffering from the effects of a deteriorating franc for more than a generation. Those who have relied upon repayments in francs have suffered the cruel loss of 99 per cent of their value since 1914. No wonder that the conservative creative middle class there has been ruined with consequent loss of national power, resulting in the present political anarchy in France!

Keynes reported Lenin as having said that the best way to weaken a capitalistic country, to take it over for communism, was first to debauch its currency. That is done by denying to the people the use in their exchanges of any fixed monetary standard expressed as a definite weight of precious metal. Napoleon, whose works are studied by military men, announced in 1797, when the policies of the Revolution had ruined the currency of France and had left her isolated and threatened by enemies, that he would never, so long as he lived, resort to the printing press. He, contrary to the common practice of dictators, returned to a metallic standard—silver and gold. It is as stupid in time of war or threat of war to abandon a sound standard of value as it would be to confiscate all calipers and micrometers in time of war on the grounds that we should not measure accurately what we are doing in wartime. A recent

Norwegian book by T. J. B. Hoff, "Economic Calculation in a Socialistic Society," shows that even socialist societies have to reintroduce prices and concepts of value in order to organize production and distribution.

Having mentioned a few of the difficulties arising from the kind of monetary and taxation systems under which we are living, let's get back to the fundamental unit, the dollar. At present and since March 6, 1933, it has been forbidden for Americans to own or use gold or gold coins for money. Yet we continue to make good to foreigners, through central foreign banks, redeeming their dollar credits on the U. S. Treasury at the fixed rate of $35 per oz of gold as established on January 31, 1934. On November 10, 1953, our Treasury had lost $1,261,000,000 in gold so drawn out over the amount of gold acquired during the past twelve months.

It was on the advice of principal members of the Committee for the Nation, aided chiefly by the agricultural economist, George Warren, of Cornell University, that our Government, contrary to its platform pledge in 1932, went off the gold standard for its own citizens. It was contrary to advice of more than 94 of the qualified American monetary economists polled at that time. The Economists' National Committee on Monetary Policy was formed to warn the people of the eventually evil consequences of that policy. It was as if our Government had called in a group of farmers to establish standard gear designs for use in America, despite the objection of a committee of The American Society of Mechanical Engineers comprising the largest qualified group of engineers and manufacturers concerned with that subject. Doubtless the Administration then in power could not find a qualified monetary economist among the American stars of that science, who would not expose the fallacy of Keynesian economics for the long run. Keynes himself qualified his theory as suitable only for the special case. His ardent followers forgot to read attentively his complete theory as they were anxious to try the experiment of tampering with the standard of value. And also, facts now revealed show that among the advisers of the Government, close to the President, were many communists in high positions.

NOT FORCED OFF THE GOLD STANDARD

We were not forced off the gold standard! The Roosevelt Administration deliberately abandoned it; and the resulting system met with the approval of and has been furthered by the communists who have infected our Government, particularly in the U. S. Treasury. There was more gold in the U. S. Treasury January 1, 1933, than there had been in any month in 1929 (the range was from $3,828,000,000 to $4,094,000,000) when it had supported a very high amount of credit and sustained prices. There was very little drain on the U. S. Treasury by U. S. citizens' conversion of Federal Reserve Notes or of gold certificates into gold coin. They wanted cash, not gold; they had faith that their currency was and would be redeemable in gold. The circulation of gold coins was 2.23 per cent of the total stock in 1928; 2.05 per cent in 1929; 1.68 per cent in 1930; 1.81 per cent in 1931; 3.64 per cent in 1932. The biggest drain was in bullion withdrawals by foreigners in October, 1931, to June, 1932. Our action in going off the gold standard was the equivalent of fraudulent bankruptcy—the action of a solvent debtor concealing his assets to cheat his creditors.

Why should we continue a policy which exposes us to drains of gold to foreign countries, while denying the same protection to the U. S. citizen whose toil, ingenuity, and risk-taking caused the gold to be in the Treasury in exchange for the products of his work? Especially is there no sense in this discrimination when the evidence shows that the American citizen has shown more trust in his Government than have foreign central banks and governments. Their percentages of withdrawals during the period between October, 1931, through June, 1932, ranged from 8.15 to 15.83 per cent of our total gold stocks and that involved a very high percentage of their total claims against our gold. Those in authority in any administration who fear that the people would refuse to leave their money in the Treasury if they were free to convert it into gold coins are pointing the finger at themselves as contemplating actions of which the people would not approve.

Let's get back to the fundamental unit which appears as the right-hand side of any economic equation which we engineers have to make; that figure is preceded by the dollar sign; it is half of the problem. It's high time we engineers took a look at it.

FUNCTIONS OF THE DOLLAR

What are the functions which a dollar has to perform? Let me list them briefly.

The unit of value, if good, is required to act (1) as a fixed common denominator and yardstick for day-to-day transactions in our own country; (2) to serve equally well as a standard in deferred transactions, that is, when one party does something in consideration of payment after a period of time has elapsed; (3) in the form of coin as a store of value upon which free citizens can rely; (4) as a common denominator and, in the form of coin, as a settler of balances of payments in transactions between persons in different parts of the world, that is, in international exchange; (5) in the form of coin as asset reserves for central banks; and (6) most importantly, as a check upon predatory governments which otherwise would build up political machines and take over the ordering of the economic lives of the citizens for the benefit of themselves and their political followers, by seizure and manipulation of the monetary standard and currency.

I shall not bore you with an analysis of reasons why the gold-coin standard meets the requirements of each of the foregoing six functions better than any other as all experience throughout history has shown.

It may be more heart-compelling to relate only the circumstances under which the gold standard and a redeemable currency as a store of value protect our women and children. They need that protection. But so do the children of the mind. Our members know the birth pangs of invention.

How do new jobs come up in your town? Very often it's the result of an invention. Sometimes it is the consequence of what we may call an innovation, that is, trying something brand new. If the inventor or innovator has enough money on hand, already saved for such an opportunity, he is able to buy what is needed to operate the idea to see whether it works out and yields a profit. If he doesn't have enough money himself to start, he may take in a few partners who have enough money among them which they can risk.

A letter to the *New York Times*, published August 30, 1953, under the caption "Defining Inventions," says in part, "Inventions, after they are made, are of necessity obvious, for each step in their creation, when all the facts are known, must appear as a correct and logical step. An 'invention' which did not follow the laws of nature would not work. But before an invention has been made the steps were not logical; had they been so, someone else would long before have taken them."

When Henry Bessemer in 1856, believed it practicable to make steel by blowing air through molten pig iron he had already earned and saved considerable sums of money by use of his earlier inventions, notably the manufacture of bronze paint. He says in his *Autobiography*, "After a full and deliberate con-

sideration of the whole case I resolved to continue my researches until I had made my process a commercial as well as a scientific success—there were duties which I owed to myself and to my family. Having thought thoroughly over the risks and powerful opposition I had to fight, I came to the conclusion that it was my duty to settle the sum of £10,000 ($50,000) on my wife, under trustees; so that I could not be ruined absolutely in further pursuit of my invention or by litigation in defense of my patent rights. After this investment I had still £12,000 ($60,000) to spend in perfecting my process if found necessary. My partner, Mr. Lonsdon, who had implicit faith in me, intimated his resolve to go heart and soul with me in bearing his share of the cost."

Bessemer came by his use of a store of value naturally. He describes how his father, a talented mechanical engineer in Paris, and inventor of the portrait lathe, caught in the disorder of the French Revolution, escaped during a lull in the hostilities, taking his family to England, bringing with them a vast quantity of paper money, assignats, which proved to be worthless, but, more importantly, a considerable sum in gold coins. With the latter he was able to establish himself as a diemaker, and later made dies for the Caxton printing type. As a personal testament I can tell you, only because it is an example known to me, that a store of value $71,500 in my hands in 1938 enabled me to try out my metallurgical idea of making hard carbide crystals under various molten metals providing profitable employment for 12 men in 1938, and 1300 men in 1953. I am sure that in my audience are many who share my experience that good ideas don't grow without a store of value in the hands of those fathering the idea. If it's really new it is by definition not likely to be recognized by existing authority, least of all by a group of governmental planners. Developments of all sorts, by free individuals, are facilitated by private use of money as a store of value. I know of none which serve so well as gold coins or gold convertible currency, in the protection of the individual against the follies of planners with paper money. To deny to the American citizen the use of monetary metal in which our dollar is defined, namely, one ounce of gold being $35, is to deny to him the best type of a store of value.

It is not a mere coincidence that the curve of patent applications as an index of the birth rate of new ideas fell sharply after 1933. Centers of initiative require centers of private capital to be effective.

I shall skip over other functions of the money of which a good standard unit is made, important as they are, to the sixth. The sixth is a check upon predatory governments who would otherwise build up political machines and take over the ordering of the economic lives of citizens for the benefit of themselves and their political followers by seizure and abuse of the monetary standard.

GOOD MONETARY UNIT EXPRESSED IN TERMS OF GOLD OR SILVER

In a free country a good monetary unit is expressed in terms of a metal—gold or silver—having intrinsic value independent of the ruling politicians. Before 1933 our dollar had been that kind of money. Throughout our history since 1792, except for the relatively short periods of suspension of redemption by our banks and the suspension by our Government from 1861 through 1878, our paper currency was redeemable or convertible into a certain weight of gold (or gold or silver so long as we had bimetallism) at the free option and choice of the holder of paper money. Our years of redeemable currency brought us great prosperity. The 17 years of irredeemable currency during and following the Civil War were ended by the resumption of specie payments in 1879. That ended the depression of 1873 to 1879, and ushered in the era marked on the economists' charts as the "Gold Standard Resumption Prosperity." Strange as it may seem to many of us, it is probable that more, rather than less credit may exist when we have the confidence engendered by the gold standard, than when the "promises men live by "are threatened by destruction of the bridges between man and man. That was our experience following resumption in 1879. Persons in various countries or over various stretches of time can make exchanges facilitated by the gold standard. Investment can go on with greater confidence.

Those espousing one or another of the monetary theories offered in defense of irredeemable currencies are ill-advised in trying to attain their objectives by those means. The paper money and credit resting upon a gold standard require a degree of management too, but such management is restrained by the requirement that the currency be kept redeemable or convertible on demand of the holder into the standard of money at a fixed legal ratio.

The electrical fuse is a necessary part of an electrical system. It warns us when we are overloading the circuit. The gold standard redeemable currency people merely wish to put back that useful measure of precaution before we burn the house down by overheated wires. Someone in political circles said that we shouldn't throw on the brakes suddenly on a 20-ton truck going down hill at 60 miles per hour. The gold standard is like the best set of hydraulic brakes man has devised. It slows us down at dangerous times, gradually and steadily. Then we can resume speed when it's safe. At present the car is without brakes until we have resumed the redemption of currency in gold for American citizens. I ask you, whether we can make greater average speed, up hill and down dale, in a day's run with a car lacking good brakes, or with a car having effective brakes? What do you do when you find your brakes are not working? I slow down and creep along to the nearest service station to get the brakes repaired. Yet a theoretical view might be that because brakes hold a car back, retarding the forward movement at times, that we are better off driving without them. On the contrary, we can make better progress in a car with good brakes, and with a monetary and credit system which we can trust not to run wild.

The Republican party platform included a pledge to "restore sound money freely convertible into gold coin." Hearings on the Bridges-Reece Gold Standard Bill may be expected this winter. We are taking the car into the service station to install the brakes so that America may resume its rapid progress with safety.

If the engineering profession in its practical designing were to become endangered by political tampering similar to that forced upon us by an irredeemable paper currency, do you think that the engineering societies should sit idly by? If your high standards of engineering were to be cut merely because of the present shortage of competent engineers, would you think it a satisfactory solution to your problems? Your answer would be a definite "No." No more is the inconvertibility of the dollar a solution of our monetary problems.

My remarks have been designed to direct attention to the striking parallels between the present perils of false thinking in monetary policy and those engineering problems with which we are familiar. I have attempted to trace the connection between our liberty and a currency convertible into gold at a fixed rate. There is much work to be done to get America on the road again. Let's do it! We should be people who recognize and understand the importance of acting in accordance with tested experience.

SYNTHETIC RUBBER *Protects the* NAVY'S PROPELLER SHAFTS

By E. A. BUKZIN

SUPERVISORY MATERIALS ENGINEER, BUREAU OF SHIPS, DEPARTMENT OF THE NAVY, WASHINGTON, D. C.

STERN-TUBE shafts are those sections which are aft of the main stuffing box in the hull of the ship and thus are protected by the hull, although they are exposed to the sea. Normally they are supported by water-lubricated bearings at their fore and aft extremities, Fig. 1. Intermediate shafts are those sections between the end of the aft stern-tube bearing and forward of the aft strut bearing. Its coupling to the tailshaft usually is forward of the aft strut bearing. The tailshaft is tapered and keyed at its after end and the propeller attached thereto.

Rubber covering of stern-tube shafting was first observed on the old *Leviathan* after the First World War when our Government accepted this ship as part of its reparation payment from Germany. After years of experimental installation, rubber covering of stern-tube shafts became standard procedure in 1939. Rubber covering was then recognized as offering complete and long-term protection against corrosion and erosion.

EARLY APPLICATIONS OF RUBBER TO SHAFTING

Since the stern-tube portion of the main propulsion shafts is not accessible for maintenance except by pulling the shafts during dry-docking, the expense of natural-rubber and subsequently synthetic-rubber coverings was more than justified. In several instances during the middle thirties, exposed shafting likewise was rubber-covered on some of our Navy's ships; however, it was felt that the expense was not justified since the quality of workmanship left something to be desired. Also, as potential mechanical damage resulting from fouled wire rope and other debris was present, it was considered that the use of standard paint systems between regular 9-month overhauls was adequate. With the advent of improved antifouling paints, regular overhauls were extended to 18-month intervals. Since 1939, and all throughout the war years, vulcanized-rubber covering, plus antifouling paint, usually the hot-plastic type, was the accepted method of protection of stern-tube shafts for all combatant Naval ships. As a result of the natural-rubber shortage it became imperative in 1941 to use synthetic rubber in lieu of natural rubber for this and many other purposes. Satisfactory synthetic rubber was applied as early as 1943.

SHAFT FAILURES

During the latter phases of the last war and the years subsequent to it, it became apparent that shaft cracks and complete shaft failures were becoming quite pronounced. Such failures were analyzed to result from the severe stresses developed close to the ends of the shafts or under the bronze sleeves shrunk onto the steel shafts in way of the water-lubricated bearings. Such shaft failures usually were observed at the strut bearings—both the intermediate and main struts. These failures were more pronounced on our high-speed ships, particularly destroyers, where enormous power transmission is required.

Contributed by the Rubber and Plastics Division and presented at the Annual Meeting, New York, N. Y., November 29-December 4, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

FIG. 1 APPEARANCE OF 2-FT SECTION OF UNCURED SYNTHETIC-RUBBER SHEET IN WAY OF A WATER-LUBRICATED BEARING JOURNAL ON AN AIRCRAFT-CARRIER PROPELLER SHAFT

It was considered that the waster rings, consisting of mild steel, which were applied at both ends of the bronze journal, were not performing the functions expected of them in that the cracks in the shafts usually were found beneath the waster ring or within a few inches of the ends of the bronze journals. Accelerated corrosion which was supposed to be taken up by these waster rings did not limit itself thereto. In addition, fretting corrosion was observed under the rings. Frequently, steel waster pieces and zincs inadvertently get painted and then their function is further impaired or lost entirely.

NAVY DECIDES TO USE RUBBER SHAFT COATINGS

Conventional underwater painting systems were recognized to be unsatisfactory and rubber covering of these exposed shafting sections was adopted by the Bureau of Ships as a dependable means of protection. After the waster rings are removed, the shafts are magnafluxed to detect internal defects and repairs are made to the shafts as required. It is emphasized that performance and material specifications have been developed since 1940, which have overcome previous procure-

FIG. 2 APPEARANCE OF SHOP-APPLIED RUBBER SHAFT COVERING ON THE USS "BROOKLYN" AFTER OVER 15 YEARS OF SERVICE
(Note the many coats of paint and distinct wrapping marks in rubber under antifouling paint layers.)

FIG. 3 APPLICATION OF WET TAPE TO SAME 2-FT SECTION AS IN FIG. 1, PRIOR TO VULCANIZATION

ment difficulties, and which insure satisfactory materials as well as competent technique of application. The soundness of the decision to use vulcanized-rubber shaft coatings was further confirmed after an examination of the rubber-covered exposed shafting on the USS *Brooklyn*. The rubber covering was in excellent shape 16 years after its application, Fig. 2.

Dry-dock shaft covering involves certain compromises in the types and techniques of rubber covering which can be applied without delaying the ship's docking periods excessively, or running costs up too high. It is recognized that vulcanized sheet rubber undoubtedly constitutes the best covering. Such covering is applied in two ways, depending on whether the shaft is hollow or solid cross section. Hollow shafts are covered by the application of semihard rubber with a soft-rubber top covering all vulcanized in place through the application of steam through the bore of the shaft. In the unvulcanized state, these materials are semiplastic in nature, much like bread dough which has been rolled into a sheet. They are tacky and require no cement except in respect to the metal surfaces. Pressure normally is required during the vulcanization process and is obtained by wrapping wet cloth tape around the outer surfaces, Fig. 3. The tape shrinks when the water evaporates as heat is applied to the bore. Induction coils may provide vulcanizing heat for short sections, Fig. 4.

The over-all thickness of the rubber shaft covering is normally about $^3/_{16}$ in. The rubber is anchored mechanically onto the bronze journals through a series of dovetailed grooves cut into the journals. In the case of solid shafts, the hard-rubber underlay is dispensed with, since curing such material requires more heat than normally can be applied from the outer surfaces of the shaft covering during vulcanization. The same technique of applying wet tape, which subsequently is removed, is used to develop the pressure to compact the rubber and avoid lamination.

TYPES OF SHAFT COVERINGS

In recent years, rubber coatings have been developed which, though they are not quite so tough and may not adhere so well as the vulcanized-sheet types mentioned previously, offer superior protection when compared with the presently known paint systems. These coatings usually are described as brush-on neoprenes and flame-sprayed polysulphides or thiokol.

The application of flame-sprayed polysulphide (Fig. 5) poses numerous problems. For a number of years we attempted to live with these problems. Highly trained personnel are required for application. In addition, flame-spraying of polysulphide powder has annoying physiological effects due to the obnoxious odors common to most polysulphide rubber materials. Owing to difficulties of application, and variation in the quality of the coating obtained, the Bureau has eliminated this method as a shaft-covering technique.

Flame-sprayed thiokol does not provide the protection desired since there are space limitations for flame-spraying. Furthermore, a poor applicator using mediocre techniques can produce coatings which have relatively poor service life.

Brush-on neoprene is not a cure-all since it too has certain peculiarities which often are difficult to overcome in a shipyard. Care must be taken in applying each layer so that solvent entrapment may be held to a minimum. Likewise, care

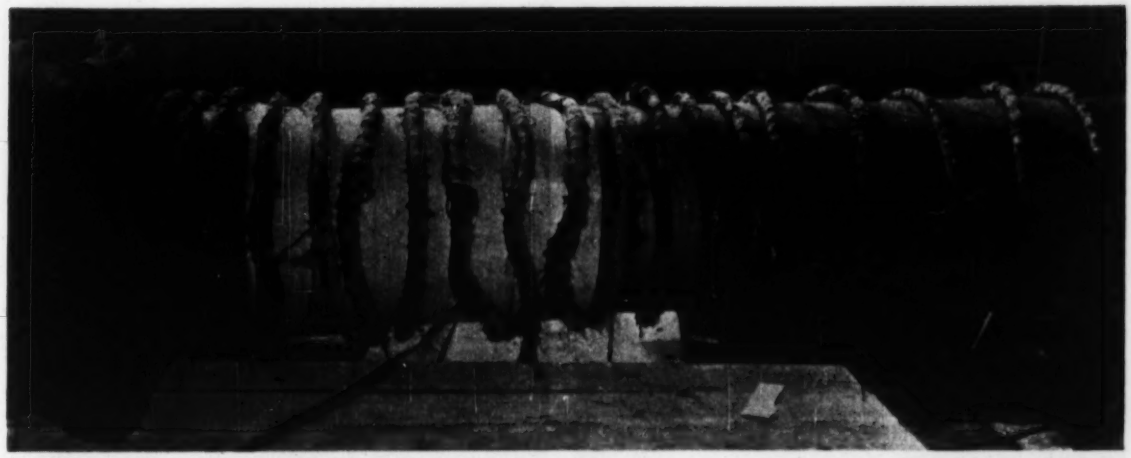

FIG. 4 VULCANIZATION PROCESS WITH HEAT PROVIDED BY INDUCTION COILS AS DEMONSTRATED ON THE SAME AREA AS FIG. 3

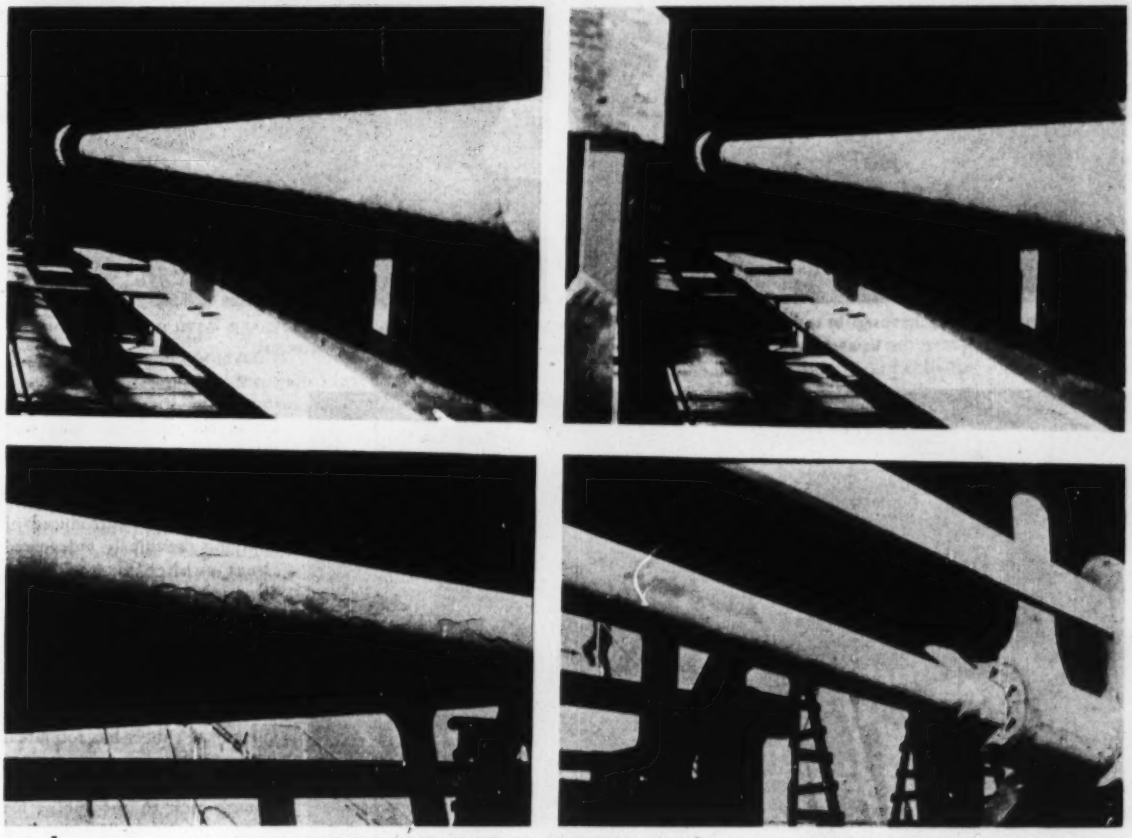

FIG. 5 APPEARANCE OF EXPOSED PORT PROPELLER SHAFTS OF DESTROYER COVERED WITH FLAME SPRAYED POLYSULPHIDE RUBBER AFTER ABOUT 20 MONTHS OF SERVICE

must be taken during the curing process that the rate of heating is not too fast or too slow. Curing is done at moderate temperatures, say, 180 F, and is effected by blowing hot air over the surface.

It has been recognized that the ideal method would be to apply sheet rubber to a shaft in place in the dry dock since superior protection would result. Several such processes have been attempted. Unvulcanized synthetic rubber was applied on the shaft of a destroyer escort about $2^1/_2$ years ago and cured by blowing steam into an enclosure provided by a tarpaulin draped over the shaft. The necessary pressure to avoid lamination and porosity in the coating was obtained by the ap-

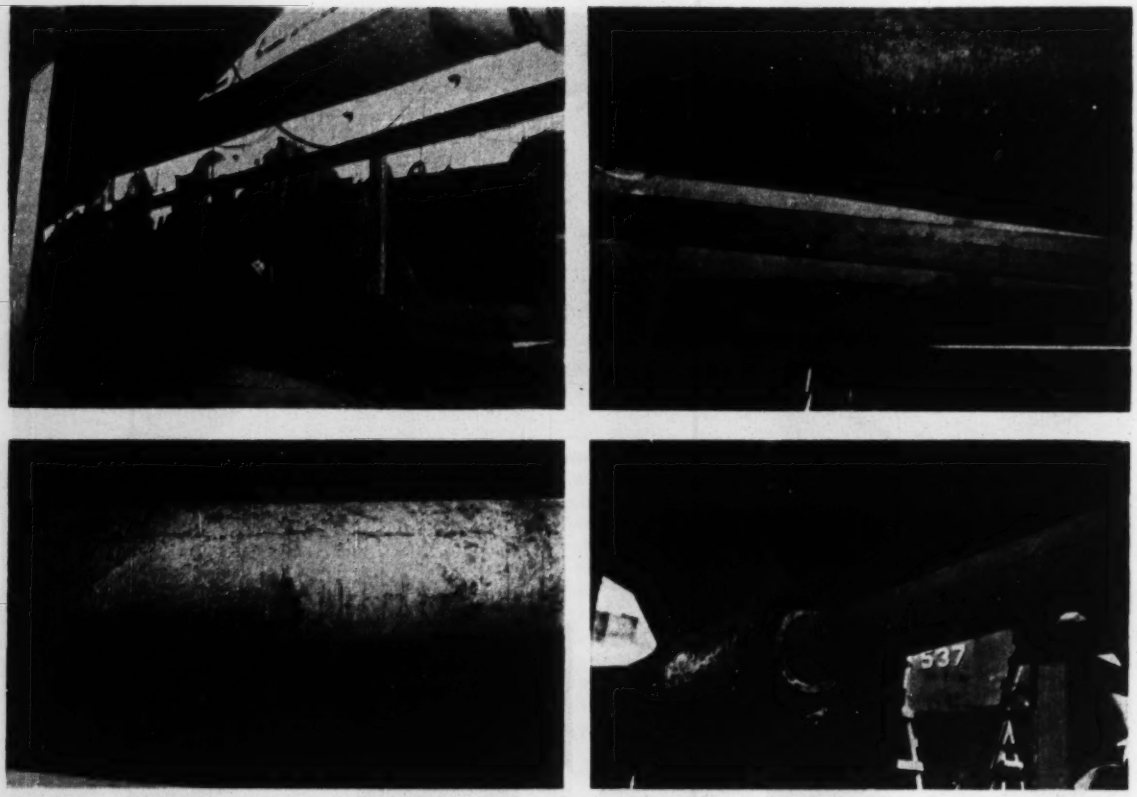

FIG. 6 APPEARANCE OF EXPOSED STARBOARD PROPELLER SHAFTS OF SAME DESTROYER AS FIG. 5, COVERED WITH A GR S SYNTHETIC RUBBER APPLIED AND CURED IN PLACE IN DRY DOCK AFTER 20 MONTHS

FIG. 7 EXPOSED PROPELLER SHAFT COVERED WITH CEMENTED PRECURED NEOPRENE SHEET RUBBER IMMEDIATELY AFTER APPLICATION

plication of friction tape which was drawn down tight on the outer covering and left in place after the cure was completed. Examination of this rubber covering about 20 months after application, Fig. 6, indicated that, except for some slight loosening of the friction tape in one area, the shaft covering was intact and performing its function properly.

About a year and a half ago a technique was introduced of applying previously vulcanized sheet rubber to steel shafts through the use of an outstanding neoprene cement, Fig. 7. It is important that the sheet be applied in sections and not in excess of $^1/_{16}$ in. thickness. This was required since vulcanized rubber has too much snap, compared to unvulcanized rubber, for cements to provide enough tack to the rubber for it to conform to the pits and irregularities in the surfaces of shafts which have been in service for some time. If a minimum of two thicknesses is then applied one over the other and the seams staggered approximately 180 deg, the desired protection appears to be possible. The adhesion developed by the cement both between rubber and steel and rubber to itself is in the same order as that which

(*Continued on page 28*)

ENGINEERING AMERICA'S FUTURE

By GWILYM A. PRICE

PRESIDENT, WESTINGHOUSE ELECTRIC CORPORATION, EAST PITTSBURGH, PA. AFFILIATE ASME

I HAVE been deeply impressed by the truly great contribution this Society has made through nearly three quarters of a century in carrying out one of the objectives that was laid down in the founding meeting in 1880, that is, "the collection and diffusion of knowledge among men."

In the course of the years many distinguished gentlemen have addressed this body. Among these was one of the first honorary members and a President of the Society, George Westinghouse. Hence it is a special privilege to address a message to the Society over which he once presided.

A TURNING POINT IN THE NATION'S ECONOMY

Nineteen hundred and ten, the year George Westinghouse served the Society, now is rated among economists and historians as one of the most significant of our history. The Harvard economist, Professor Leontief, points out that in 1910 a real turning point in this country's economic and social development occurred. That was the year, he says, when the last wave of immigration reached its crest; the year, too, when our rural population began to decline in absolute terms. In 1910 the amount of energy generated by the labor of men and animals reached its peak, and machines increasingly took over. One year earlier the model T Ford started to roll off the first continuous production line, and the result was felt almost immediately in shorter working hours. This shift to mass production by machine marked the beginning of what has been called the most sweeping revolution man has ever known.

Our rapid industrialization was made possible by a combination of favorable factors rather than by any one cause; but certainly the application of engineering principles to business and industry was the heart of the formula. The application, of course, was made by the engineer himself, working in many fields. Notably, it was made by the mechanical engineer, for in his company, his industry, and his professional society, he developed and applied the standardization of industrial parts and procedures on which our mass-production economy is built.

I do not propose to dwell, however, on the accomplishments of the past 43 years, nor to indulge in that vice so often attributed to Americans—the habit of self-congratulation. All that lies in the past, and as Joseph Stalin—of all people—once observed, "The past belongs only to God." I am concerned, rather, with the problems of the present and the needs of the future.

SOLVING TODAY'S PROBLEMS

Those problems are not simple and those needs are not trivial. In this century we have found remedies for evils that have cursed mankind for thousands of years, but we have generated new evils that demand new solutions. There are aspects of American life today that must rouse any order-loving engineer to anger and make any citizen of our land blush with shame. For example:

The president of the American Bar Association last March called us "the most lawless people in the world." An associate justice of the U. S. Supreme Court only a month ago declared that the nation is plagued "with unprecedented juvenile delinquency, gangsterism and shocking crimes, followed only by long-delayed punishment or none."

Having last year killed our millionth human being in traffic accidents, we are now working on the second million at the rate of almost 40,000 deaths annually. American industry has engaged in a maximum effort to reduce its accident rate, but the great gains here have been virtually canceled out by this senseless and avoidable slaughter.

We have two and a half million illiterates in this country. Our children are suffering from a shortage both of public schools and of teachers. Some of the schools in daily use in many parts of the land are really ancient.

Mental illness is fast becoming the major national health problem. During World War II we rejected or discharged two million men for personality or psychiatric reasons.

Our cities are littered with rubbish and still spotted with slums that are not fit for people to live and grow up in. Our national standard of housing is far below our over-all standard of living. Most of our cities, and all the large ones, are choked with traffic congestion. A recent study estimated the yearly cost of traffic jams in the City of New York at more than a billion dollars.

Our industrial productive machine has been expanded enormously in the past dozen years, and we take great pride in our physical plant. And yet economists point out that we have merely caught up with the ground we lost in the depression. They also tell us that Soviet Russia, the enemy of free man, is amassing capital, training engineers, and building up plants at a faster rate than we; and that in certain major industrial products it now has an output comparable to that of all Western Europe. Well, what do we do about it?

Part of the answer is simple. We do more of what we have been doing in the past, and we do it faster and much more efficiently. Wherever technology is concerned—wherever problems are subject to physical solutions—we are the masters of our fate. We can put up the schools we need, clear out slums, build better roads, perfect our industrial machine. We can accomplish these things as we have overcome even graver problems in the past—by the application of engineering principles to business and industry. There is almost nothing that we cannot do, if we bend our national will to doing it.

THE NEED IS FOR ENGINEERS

I hesitate to state the obvious; but the first requirement of such a national effort in engineering is—engineers. The deficit is now critical. Unfortunately, we shall have to live with this shortage for years to come.

Address presented at the Annual Dinner of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York, N. Y., December 2, 1953.

My own industry shares this great need, and a considerable portion of our need is for mechanical engineers. We need them because we make things from materials, and because materials and their applications stand high among our most pressing problems. We need mechanical engineers for research and development, for design and production. We need them for new products and devices, and we need them for new developments on old-line apparatus. It may be surprising to learn that we now have about as many mechanical engineers in our employ as we have electrical engineers.

To a considerable extent, the turbine generator, the most basic of our 8000-odd products, has been improved to its present condition through mechanical engineering. In 1941 the largest 3600-rpm machine in service was rated at 65,000 kw. Today we are building a 250,000-kw turbine generator which will weigh 34 per cent less and occupy 30 per cent less space, per kilowatt, than the smaller machine. This improvement was made possible by better design and by the application of better materials. One of the most significant turbine-generator developments in recent years is a new method of cooling by forcing hydrogen through hollow copper conductors in both rotor and stator. Mechanical engineering played a key part in this development.

If the first requirement of a national effort in engineering is that we train engineers, the second requirement is the equally obvious one that we use them intelligently once they are trained. We are not altogether doing that. Of the inadequate number of engineers graduating last June, about half were tapped for the Armed Services. Approximately one third of the country's engineers have reserve commitments and presumably will be called up for service in an emergency.

I am acutely conscious of the moral and ethical problems involved in deferring our young men of the professions and sciences. I think I understand the resentment felt and expressed by parents who see their neighbor's son deferred and their own young man drafted. Nevertheless, it is against the country's own interest to throw our educated technologists helter-skelter into the Armed Services, where they will lose several years' training and may be diverted from their professions. These men are one of the keys to our national survival. It has been pointed out that about half the technical personnel in the first atomic-bomb project were students when the war began and under 26 years of age in 1945. Consider the cost to us if these young men had been drafted for purely military service!

ENGINEERING SOLUTIONS TO SOCIAL PROBLEMS

I have said that wherever our problems are physical and subject to technical solutions, we can achieve whatever we need to achieve—provided we train the technologists and utilize their talents properly. Unhappily, however, many of our most dangerous problems are not physical and will not be solved by better research, higher productivity, or any of the other industrial virtues. I refer to the social illnesses that afflict our age. How to cope with these is probably the most perplexing internal problem we face.

Engineers hold part of the answer in their hands. They have successfully applied engineering principles to industry. Now our hope lies in part in the application of those principles to our social problems.

With all possible deference, I suggest that the engineer himself—the man who knows most about the physical facts of our world—should attempt to make that application. I suggest that members of this Society undertake a greater share in meeting the crisis we face. I ask that they help to bring sound and efficient management to government at all levels; that they analyze and attack crime, illiteracy, poverty and slums as they would analyze and attack any major problem in their several fields; that they act as a catalyst for producing action among many groups in order to remedy conditions that are unworthy of civilized men in the middle of the Twentieth Century.

I do not present this thought as a duty or an obligation, but rather as a challenge and an opportunity. Nor do I offer it as a new idea. I know that this plea to the engineers is being frequently presented, and that by now they may even tire of hearing it made. Nevertheless, as Bernard Shaw once said, a thing which not enough people believe cannot be proved too often.

This is not the first time that members of the ASME have been asked to broaden their scope and to enter a new field. The eighth president, Henry Robinson Towne, did it 64 years ago, in his famous address "The Engineer as an Economist." He outlined what was then a startling proposition, asking a group of men proud of their newly won professional standing to give their prestige and integrity to the world of business. Specifically, he asked his fellow mechanical engineers to enter the field of shop management, to become successful managers of industrial works, to make themselves "qualified to supervise, either personally or through assistants, the operations of all departments of a business, and to subordinate each to the harmonious development of the whole."

The engineering profession, of course, accepted that proposition as an opportunity, and so played an ever-larger role in the nation's development and welfare. I now ask its members to consider the desirability of joining with others to give their talents and prestige and integrity to this broader cause—the social and moral improvement of mankind.

ENGINEERS WELL FITTED FOR PUBLIC SERVICE

In my opinion, the engineer is not only the ideal man for this work, but also stands in an ideal position to perform it. He is everywhere respected for his character, his competence, and his record. He is welcomed by all groups and can talk to all types of people. He might successfully erect a bridge between the technical and the humanistic world, and bring diverse groups together into a common program as no one else is equally capable of doing.

Although he is so admirably fitted for the roles of citizen and public servant, it is my impression that the engineer has tended to stay clear of such commitment. Out of curiosity on this point, I have made a layman's analysis of the civilian professions of some of our political leaders. Of the governors of our 48 states, 28 are lawyers. There are businessmen and pharmacists, salesmen and auto dealers, farmers and editors; but I can find no engineers.

Of the 96 United States senators, seven were farmers, six were teachers, 16 were businessmen, 53 were lawyers. Only two were engineers. Yet there are about 400,000 engineers in this country, and about half as many lawyers.

Now I think the attorney-at-law brings an ideal training to public service. As a member of the bar, and one who served a term many years ago in the Pennsylvania legislature, I am sure I shall not be accused of bias when I say that many valuable talents lie outside the legal field, and that our state capitols and the Congress of the United States could advantageously use the services of more engineers. Legislators in this modern world are far more than lawmakers. They must investigate and analyze, manage and appropriate. They must on short notice become experts on airfields in North Africa, hydraulic power installations in the Northwest, cotton growing in the South, and the foreign-trade problems of Japan. The trained engineering mind could bring a rich contribution to all of these jobs and

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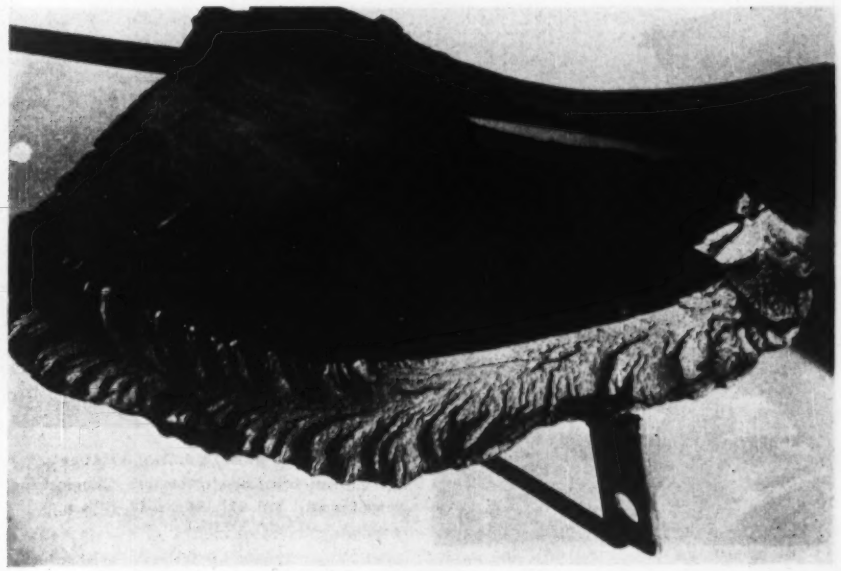

FIG. 1 FRAGMENT OF A FRACTURED DRUM
(Note shiny, faceted appearance. Apices of herringbone markings point to origin of failure.)

Brittle Failure of NONSHIP STEEL-PLATE STRUCTURES[1]

By M. E. SHANK

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INTRODUCTION

THE problem of brittle failure was brought into sharp focus during World War II with the breaking up at sea and at dockside of welded-steel merchant vessels, especially Liberty ships and T-2 tankers. Data relating to ship failures have been well correlated, and a great amount of research has been stimulated. As a result, much light has been shed on problems relating to the brittle failure of steel. No similar central repository exists in the case of nonship structures. A survey was therefore undertaken to gather and correlate such data, in order to supplement the study of the ship-failure problem. This article is a brief summary presentation of that survey

In particular, such a nonship survey reveals how widespread is the brittle-failure problem in nonship industries, how long the problem has existed, and to what extent the problem is being met and solved. It is seen that brittle failure can and does occur in all types of pressure vessels, tanks, bridges, power equipment, penstocks, and gas transmission lines. Further, it can occur in totally unexpected fashion in structures that have been designed and built carefully. Oftentimes a great loss of life and property ensues. The factors of importance in cases of actual service failures are presented in the following.

Carbon-steel plate, when stressed in an ordinary tension test, normally fails in ductile fashion. There is considerable energy absorption, accompanied by plastic deformation. This same material, however, under the proper conditions, can fail in a brittle, catastrophic manner. Three conditions can combine to bring about such failure: (*a*) Low temperature, such as exists in the ambient atmosphere. (*b*) The presence of a notch, introducing triaxial stress. Any defect, such as a welding crack, or void, or a crack left by a punching or shearing operation, can serve as a notch which will initiate brittle failure. Thus the term "notch brittleness" is often used. Factor (*c*) is high strain rate, or impact loading. This factor, however, is not necessary for the initiation of brittle failure. Most nonship brittle failures occur under completely static conditions.

[1] Summary of a report to the Committee on Ship Structural Design, National Academy of Sciences–National Research Council. The Committee on Ship Structural Design is advisory to the interagency Ship Structure Committee which supported this project as part of its research program. The complete report, entitled, "A Critical Survey of Brittle Failure in Carbon Plate Steel Structures Other Than Ships," is about 30,000 words in length and is documented by an extensive bibliography, here omitted. It will be published for limited distribution as a report of the Ship Structure Committee, and for general distribution as a bulletin of the Welding Research Council. A slightly abridged version will appear in a forthcoming volume of papers presented at the ASTM-ASME Symposium on Metallic Materials at Low Temperatures. This symposium was held at the 56th Annual Meeting of the American Society for Testing Materials, Atlantic City, N. J., June 28 to 30, 1953. For complete details and references the reader is referred to the full report.

The opinions expressed in this survey are those of the author and do not necessarily represent the views of the Committee on Ship Structural Design, or of the Ship Structure Committee.

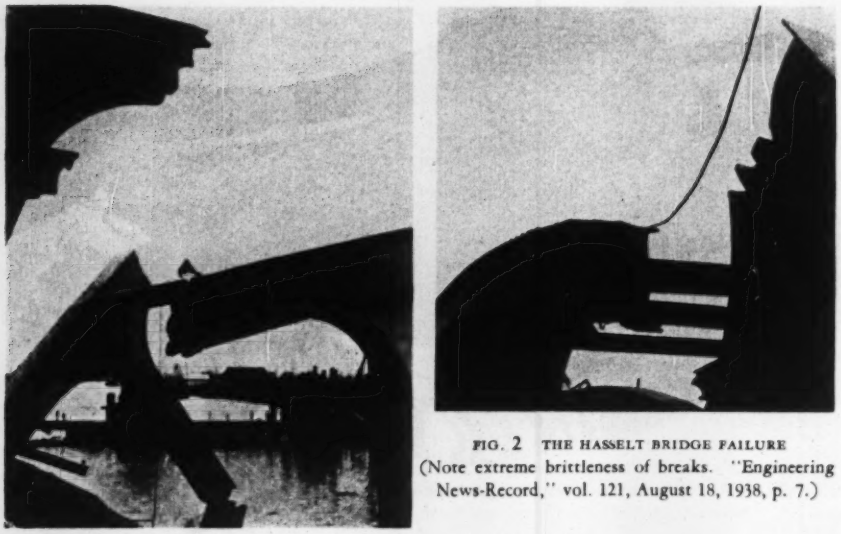

FIG. 2 THE HASSELT BRIDGE FAILURE
(Note extreme brittleness of breaks. "Engineering News-Record," vol. 121, August 18, 1938, p. 7.)

When brittle failure occurs, it may be recognized by several earmarks. Among these are the speed at which fracture occurs (approaching several thousand feet per second), almost complete lack of ductility, negligible energy absorption, and a brittle or faceted appearance of the fractured surface. Moreover, the fractured surface often has a characteristic "chevron" appearance, the apices of the chevrons pointing to the origin of fracture, Fig. 1. Finally, as noted previously, when steel plate, taken from a structure which failed in a completely brittle manner, is tested in an ordinary tension test, it manifests a high degree of ductility and strength. This last characteristic was extremely baffling to the engineers who first encountered the phenomenon.

The bessemer process of steelmaking was developed in 1856, and in 1861 the open-hearth process was invented. Prior to this time steel was scarce and expensive, and made only by carburizing wrought iron. Wrought iron, which because of its slag inclusions is an extremely tough material, was used for structural purposes. During the period from 1860 to 1890, however, wrought iron gradually was supplanted as a structural material by steel. The change came about slowly, largely because of a general reluctance on the part of engineers to discard such a reliable material as wrought iron. In the long run, the cheapness, greater availability, and superior strength of steel won out. As more steel came into use, troubles with brittle failure began to appear.

THE ERA OF RIVETED CONSTRUCTION

As early as 1879, members of the British Iron and Steel Institute complained of the mysterious cracking of steel in a brittle manner, with no ductility, usually in cold weather. In at least one case, samples from such plates subsequently met all strength and ductility requirements of Admiralty tests. The first failure of an engineering structure, however, is apparently that of a standpipe at Gravesend, Long Island, in 1886. This standpipe was 250 ft high and 16 ft in diameter at the base. It was steadied by guy wires and made of riveted plates approximately 6 ft × 9 ft. The thickest plate was 1 in. Failure occurred on the hydrostatic acceptance test, when the water reached a height of 227 ft. A vertical split appeared, running up 20 ft, and the tower collapsed. Some plates appeared to be tough and ductile, others entirely brittle. An observer on the spot commented that the cause of failure lay in the presence of defective steel plates which were brittle, and which unfortunately had been concentrated in the lower part of the tower. This fallacy was repeated in observations of subsequent failures.

Many more catastrophic brittle failures of riveted structures, such as a gas holder, water tanks, and oil tanks occurred in later years, one as recently as 1934. The most famous of these, however, was the Boston molasses tank, which was located on the Boston waterfront.[1] One January day in 1919, when the tank contained 2,300,000 gal of molasses, it burst open. Twelve persons were drowned in molasses or died of injuries, 40 others were injured, and horses were drowned. Houses were damaged and a portion of the Boston Elevated Railway structure was knocked over. An extensive lawsuit followed, and many well-known engineers and scientists were called to testify. Much conflicting testimony was presented as to the cause of the disaster. It was here that the significance of the chevron pattern in a service failure (see Fig. 1) was recognized.

Finally, after years of testimony, the court-appointed auditor handed down the decision that the tank failed by overstress. In commenting on the conflicting technical testimony, the auditor stated in his decision, ". . . . Amid this swirl of polemical scientific waters it is not strange that the auditor has at times felt that the only rock to which he could safely cling was the obvious fact that at least one half of the scientists must be wrong. . . . ." This statement fairly well summarized the knowledge (or lack of it) then current among practicing engineers, concerning notch-brittle behavior.

THE ERA OF WELDED CONSTRUCTION

In the period just prior to World War II, about 50 bridges, of a type known as a Vierendeel truss, were built across the Albert Canal in Belgium. Bridges of this type consisted of straight lower chords, with curved upper chords. The upper and lower chords were joined by verticals. There were no diagonals. The structure was a very rigid one. Some of these bridges were built of welded or rolled I-beams and plate, others entirely of plate. The span and detail were varied to suit the application. In March, 1938, the bridge at Hasselt, with a span of 245 ft, collapsed into the canal, Fig. 2. The weather was quite cold when failure occurred. Eyewitnesses heard a sound like a shot

FIG. 3 PENSTOCK FAILURE
(Proof hydrostatic pressure test produced a longitudinal brittle failure. "Welding Journal," vol. 32, April, 1953, p. 4.)

and saw a crack open in the lower chord. This left the top chord acting as an arch. Six minutes later the bridge broke into three pieces, and fell into the canal. All the fractures were brittle, some through welds, others in solid plate away from the welds. The bridge was lightly loaded at the time. Within 2 years, two similar bridges failed.

These failures set off a great flurry in engineering circles. Following the Hasselt failure, the Belgium-Luxembourg steel industry claimed that the quality of the steel was above reproach, and the failure of the bridge was due to the quality of the welds. Representatives of the welding industry visited the site and satisfied themselves that the failure was not due to the weakness or imperfection of the welded joints. Both judgments were premature.

Finally, several years later a thorough investigation was undertaken by two Germans. They reported that most failures were initiated in welds, and that many welds were defective. They found that on notch-impact (Charpy) tests practically all specimens were brittle (at least in part) at the failure temperature. Their conclusions stated that the accident was caused by (*a*) multiaxial restraint and residual stress, (*b*) low ambient temperature, (*c*) the low notch-impact characteristics of the steel. They seriously questioned whether nonkilled bessemer steels should be used in thick plate, despite good static-tension properties, since the notch-impact properties were unsatisfactory.

Several other brittle bridge failures have occurred, the most recent of which was the collapse of the Duplessis Bridge in Canada, in 1951. Similarly, the brittle failures of many pressure vessels, oil-storage tanks, a smokestack, and a penstock have been reported, Figs. 3 and 4. Fig. 5 shows a broken power-shovel boom, the end of which snapped off in cold weather. Three interesting failures in oil-storage tanks occurred in new structures that had never been filled, and which were standing empty at the time. The weld overfill on the seams inside the tank had been chipped flush during erection, leaving tiny notches. Following a sharp temperature drop, long cracks appeared across the welds, entering the plates on either side.

One of the most interesting situations, however, is that of brittle failures on high-pressure gas transmission lines which have occurred in the last few years. Pipe for gas transmission lines usually is produced under an American Petroleum Institute Standard, in several strength grades. The pipe is cold-formed, seam-welded, and usually hydrostatically cold-expanded to obtain the high yield strength specified. Raising of the yield

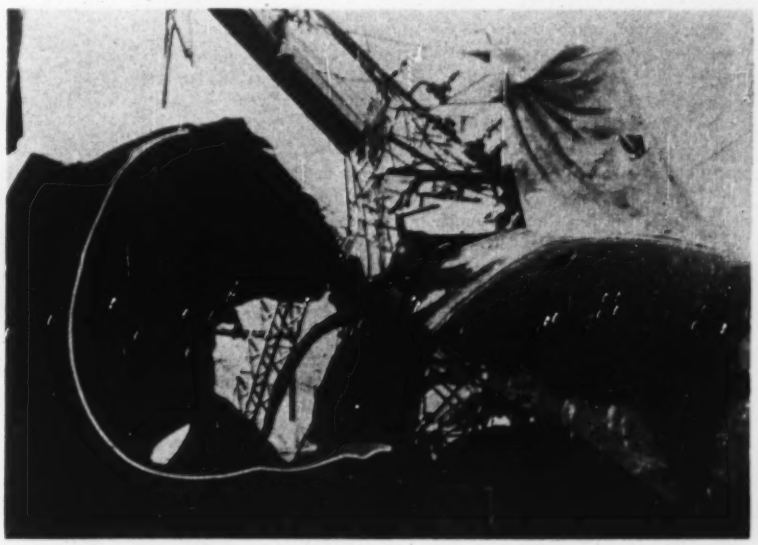

FIG. 4 FAILED SPHERE AT MORGANTOWN, WEST VA., SHOWING LONG BRITTLE TEAR

FIG. 5 FAILED POWER-SHOVEL BOOM
(End of boom has broken off.)

point by cold-expanding has an important economic consequence. In a long gas line, a considerable weight of steel is thus eliminated, since a thinner wall can then be used. Large savings result. Under an American Standards Association Code (now being revised) it is permissible in sparsely populated areas to carry a pressure (about 800 psi) which stresses the pipe at 72 per cent of yield strength. In more densely populated areas stressing to about 50 per cent of yield is permitted.

There is not much published information concerning gas transmission-line failures, but one short article describes failures as being from 180 ft to 3200 ft in length. These failures occurred on tests, after installation. The (initiating) cause is stated to be well known, namely, gouging or scratching of the plate in transit or installation. The failures always follow a sine-wave pattern and look as though there had been an internal explosion, Fig. 6. In addition to the foregoing, a report of the Federal Power Commission lists a number of "splits" of the pipe (not the weld) which occurred on test and in service. It seems probable that some of these splits represented brittle breaks, but that others did not.

Apparently no technical details on any specific pipe-line accident have been released. An interesting speculation may be made, however. Following a split, the gas pressure will be released by an elastic wave traveling at the speed of sound in methane, approximately 1300 fps. On the other hand, experimental values of 2750 to 6600 fps have been measured in brittle fracture of steel in the laboratory. Thus it appears that the gas discharge-pressure wave will never catch up with the brittle crack. The crack tip is thus always traveling in a stressed area. This would account for the long breaks just described. The gas industry is sponsoring a considerable amount of research on the brittle-failure problem.

DISCUSSION

Examination of the histories of brittle failures in nonship carbon-plate steel structures demonstrates that brittle fracture is not of recent origin, nor did it begin with the advent of welding. It also is demonstrated that brittle fracture in nonship structures is the same phenomenon as occurs in ships. This latter statement may seem an obvious one, but nevertheless it should be made.

Static Loading. In early research work (dating back to 1884) on the subject of brittle fracture, all the testing methods used to reveal brittleness employed impact-loading. This supported the opinion, widespread even to recent years, that brittle fracture in steels resulted from impact-loading. It was, however, known that if a specimen contained a sharp, deep notch, brittle failure could be induced by slow bending or slow tension. A. Mesnager, in 1906, used this fact in developing the theory of triaxial tension in notch brittleness. In the case of nonship failures, only 5 out of 64 definitely could be connected with the phenomenon of impact. Thus brittle failure can occur in the presence of static loading if the proper conditions of temperature, triaxiality (notches), and stress are present. Indeed, about 10 per cent of all very serious brittle ship failures occurred at dockside or in a calm sea.

Failures in Riveted Structures. In three cases of early riveted-structure failures it appears that the brittle cracks crossed one or more riveted joints in passage. At this late date the exact details of the crack paths are unobtainable. However, it is well demonstrated in welded ships, that on fairly rare occasions brittle cracks can propagate across special longitudinal riveted seams installed as crack arrestors. These crack arrestors are similar to the butt straps used in nonship riveted constructions. All plate welds terminate at a slot behind these arrestors.

Comparison of Riveted and Welded Structures. In comparing riveted and welded structures, failures in the latter seem to have occurred more frequently. This may be a totally deceiving conclusion, however, since no basis for comparison exists. Structural methods have changed in intervening years, different materials are used, and the total numbers of riveted and welded structures built are unknown. In the past, moreover, brittle

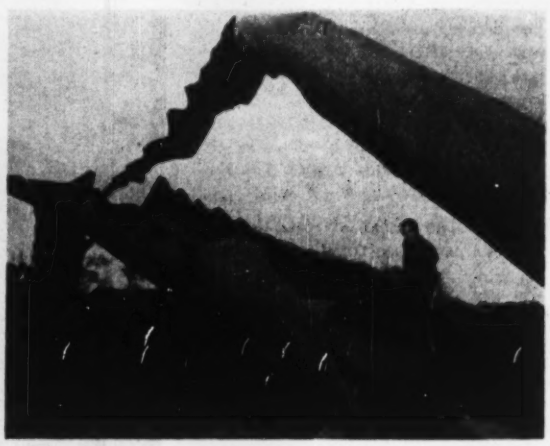

FIG. 6 FAILED GAS TRANSMISSION LINE, SHOWING SINUSOIDAL NATURE OF FRACTURE
(Note longitudinal welded seam, which appears to be intact. Presumably this failure occurred while installation was being tested—Acme photo—courtesy Lincoln Electric Company.)

failure probably has often gone unrecognized. For speculative comparative purposes, however, ship statistics may be examined. About 6000 ships, built between 1938 and 1948, are used as a basis. Since 1938 there have been about four times as many welded ships built as ships with riveted hulls or decks. Data presented show that for the same material, and essentially the same quality of workmanship, both the frequency and severity of fractures in ships increased as the amount of welding increased.

Thermal Stresses. In eleven nonship welded failures, and in five riveted failures, there had been a sharp atmospheric temperature change just prior to fracture. Two of these changes were temperature rises, the remainder were temperature drops. As would be expected, no data seem to be available on thermal stresses in tanks and pressure vessels. These stresses seem to be important in some degree, however. Thermal stresses have been responsible for initiation of several failures in ships, and studies of thermal stresses in ships are available. It is probable that thermal stresses in themselves, without additional factors (such as notches), are not too important in nonship structures. The point bears further investigation.

Residual Stresses. In eight cases of nonship failure, on-the-spot investigators blamed residual stresses. Following the failure of the tanker *Schenectady* at dockside in January, 1943, much controversy was stirred up regarding the role of residual stress in brittle failure Little or no information is available on the measurement of residual stress in full-size nonship structures. Since the failure of the *Schenectady*, however, many investigations have been performed to evaluate residual welding stresses in butt-welding of ship plate and locked-in stress[2] in ship assembly. The results of these ship investigations indicated that the basic welding stress patterns were practically the same regardless of the type of ship or where it was built. Thus the results of these investigations probably can be applied directly to nonship plate structures, at least in qualitative fashion. It was found that when a butt-weld bead was laid down, longitudinal tensile stress arose along the length of the center line of the deposited metal. The value of these stresses approached the yield point. Values of transverse stress across the weld were found to be low, about 2000 to 10,000 psi in tension. Naturally, compressive stresses must exist in the parent plate.

The question of relief of residual stress in service must then be considered. Does the stressing of a pressure vessel in service, the loading and unloading of a bridge in traffic, for instance, cause yielding and relief of residual tensile stress in a weld? For nonship structures the problem remains largely unanswered, except for some scattered and probably unreliable measurements. In ships, however, it has been found that the magnitude of locked-in stresses is not reduced materially by the working of the ship at sea. Thus, since all welded ships contain locked-in stress, and these stresses are not reduced in service, and since only a fraction of ships suffer casualities, locked-in stresses are not, by themselves, the prime cause of ship failures. Likewise, most nonship structures continue to stand undamaged.

In structures where defects exist, however, residual stresses must be reckoned with as being able to initiate failure, either by themselves or, as is more likely, in combination with other factors. The recent failure of three new, unfilled oil-storage tanks in Europe by large cracks running across the weld could have been initiated only by residual stress. These cracks were found to have started in marks left by chipping chisels. Undoubtedly, the full role of residual stress in helping to cause failure is not understood completely, even though there is evidence to show that stress relief will improve performance of materials in some measure.

Composition of Materials. Other factors shown to be important are the chemical composition of plate and metallurgical variables. For steels which are otherwise generally similar, a fully killed (deoxidized) steel will have a lower ductile-to-brittle transition-temperature range than a semikilled or rimmed (nondeoxidized) steel. Decreasing the ferritic grain size, normalizing, and use of a lower finishing temperature in hot-rolling all serve to lower the ductile-to-brittle transition-temperature range. Increasing the carbon and phosphorus contents markedly raises the transition temperature, thus promoting susceptibility to brittle failure. Increasing the manganese content has the opposite effect. Other chemical elements play less marked, but fairly well-defined roles.

In view of the foregoing it would seem that the practice of using rimming steels in the past may have contributed to brittle failure in some cases. It also is indicated that the practice of using higher carbon steels, either inadvertently or deliberately to obtain high strength, may have been contributory. In general, there seems to have been a lack of attention in the past as to steel compositions, at least in so far as the effect of composition on possible brittle failure is concerned.

Cold-Forming. Cold-forming sometimes may play an important role in brittle failure. Cold-forming of steel plate is a necessary part of the fabrication of almost all engineering structures. Several interesting pieces of research have been done on this problem with ASTM steels in common structural use. It was found that with a killed steel a small amount of permanent deformation raised the ductile-to-brittle transition-temperature range only a relatively small amount. In a rimmed steel, however, the same amount of plastic deformation raised the transition temperature by three times as much. The large difference is probably due to the great susceptibility to strain-aging (precipitation following cold work) in rimmed steels. Normalizing at 1600 F consistently restored ductility and lowered the transition temperature, while heating to 1150 F was not consistently equally effective. For both the rimmed and killed steel, large amounts of plastic strain raised the transition-temperature range by about the same amount. Thus the initial cold-working is most damaging in the rimming steel here tested, and more cold work has only a little additional effect. Data do not seem to be available on the effect of cold-forming on the transition temperature for steel taken from failed nonship structures. Nevertheless, it is clearly implied that extensive cold work will tend to increase susceptibility to brittle failure.

Welding Processes. The process of welding is of importance in the study of brittle failure. As shown by several laboratory investigations, welding in itself contributes many metallurgical variables to the state of the metal in the weld and in the heat-affected zone. Moreover, behavior of the as-rolled plate gives no evidence of characteristics in the welded material. Unfortunately, practically no data are available from failed nonship structures concerning the details of welding procedures. As a consequence it is impossible to assess, in general, the role of metallurgical variables, resulting from welding, in the initiation of brittle failure.

Structural Defects. Structural defects, such as cracks and stress concentrations, are most important in the phenomenon of brittle failure. In nonship structures for which data are available, the preponderance of failures has been initiated in both riveted and nonriveted cases at cracks left by punching or shearing, at plate offsets, weld voids, poor weld-probe replace-

[2] In ship reports it has been customary to define residual stresses as those resulting from the welding of unrestrained members. Locked-in stresses have been defined as including residual stresses and stresses resulting from other assembly and fabrication procedures.

ments, poorly repaired welds, and other defects resulting from improper fabrication procedures. Of those studied, only two failures were initiated solely by the effect of stress concentrations designed into the structure. Modification of the design of these latter structures seems to have eliminated subsequent failures. Some structural failures seem to have been initiated by a combination of design and fabrication defects.

In the case of welded ships built during World War II, however, fractures often originated at points where poor welded-design practice had been utilized (i.e., sharp hatch corners in the Liberty Ships). Following design modifications, on the other hand, the origins of most recent failures in these ships have been traced to defective workmanship. It also was concluded for ships that every facture investigated could be traced to a starting point at a definite geometrical discontinuity due to design or workmanship. While the data are not complete for nonship structures, it would appear that the latter conclusion is equally valid here. The importance of workmanship cannot be overemphasized. One ship is known to have broken in half as the result of a fracture initiating at so small a thing as a crater left by an arc strike. Equally small defects are known to have initiated nonship failures.

Crack Paths. A word might be said here about the path of a brittle crack, once failure has been initiated. Unless a weld is exceptionally bad, there is no tendency for a crack to follow welded seams. In fact, in one case, that of a 38-ft-diam-spherical welded pressure vessel, there were 650 ft of brittle tears, with 20 fragments resulting. Only a few feet of fracture followed welded seams or the heat-affected zone.

Age. In so far as age of structure is concerned, there seems to be no correlation between age and the occurrence of brittle failure. In ships this conclusion was found to be statistically valid.

Codes and Specifications. It was not within the scope of this survey, nor was it the intention of the author, to pass judgment on codes or specifications. Codes and specifications are usually the product of long and careful deliberation, conservatively based on experience in service. A brittle-failure survey, however, would be in some degree lacking in orientation if it did not take cognizance of some of the codes under which engineering structures often are fabricated, or some of the specifications under which materials are usually purchased.

To this end the ASME and API-ASME unfired pressure vessel codes, and certain codes of the American Water Works Association, the American Petroleum Institute, and the American Standards Association, as well as certain standards of the American Society for Testing Materials, were examined. All of these codes, except the ASA code for gas transmission lines, require quite conservative design stresses, usually about 25 per cent of the ultimate strength. All of the codes permit a wide variety of ASTM designations of steel plate to be used. Under the ASTM standards, for instance, some of these plate types (A-7 and A-285) can be furnished rimmed, semikilled, or killed. Some ASTM specifications do not set any limit on carbon content; others set a very high limit. API Standard 5LX (for gas transmission-line pipe) allows values of carbon and (under certain circumstances) phosphorus which are quite high. Both API and AWWA codes allow partial penetration of welded horizontal joints in storage tanks, and in so far as is known, such practice has never led to any mishap.

The American Bureau of Shipping, because of the high incidence of ship failures, in 1947, established specifications for steel plate over $^1/_2$ in. thick which put very definite composition limits on carbon and manganese contents, and which require that plate over 1 in. thick be made to fine-grain practice. Plate less than $^1/_2$ in. thick is limited only in phosphorus and sulphur contents. This last recognizes the fact that there have been no recorded failures in small ships built of lighter plate. Several industrial organizations which submitted failure reports to the survey indicated their intention of using in the future the heavier ABS steels for such varying structures as oil tanks, power shovels, and smokestacks.

The foregoing facts on codes and specifications merely serve to point up some of the difficulties of design and of steel selection and use in nonship engineering structures in so far as brittle failure is concerned. A very able exposition of this problem in regard to pressure vessels was recently presented in an interpretive report by H. C. Boardman.

CONCLUSION

It was not the function of this survey to propose a remedy for brittle failure, or to evaluate techniques of fabrication and manufacture of nonship structures. The task at hand was to survey nonship brittle failures of carbon-plate steel structures and determine the factors of importance relating to such failures, in order to supplement the study of the failure of ships. It was shown that brittle failure results from a combination of many factors. Moreover, there is at the present time no material readily available which would, if built into bridges, pressure vessels, and other nonship structures, totally prevent the occurrence of brittle fractures.

Finally, there is no known test which will surely predict from the behavior of small specimens the performance of a given steel in circumstances where structural brittle failure might occur. In short, careful design, selection of materials and good workmanship are of the greatest importance in the prevention of brittle failure in nonship carbon-plate steel structures. This is also the case in ships.

Synthetic Rubber Protects the Navy's Propeller Shafts

(*Continued from page 20*)

could be expected from most unvulcanized sheet-rubber applications of the type discussed earlier.

Recent examinations of some of the shafts which were covered in this fashion indicate that the coating is very serviceable. There is no deterioration of the bond and it would appear that this type of propeller-shaft covering will become even more popular since, from the standpoint of protection provided at relatively little cost, and the reduced time in dry dock, a satisfactory coating is obtained.

This type of rubber covering may be adopted for the protection of other metal surfaces which offer serious corrosion problems and are subject to cavitation damage, such as rudders and struts. These are presently protected by the application of flame-sprayed thiokol. We have tried to use brush-on neoprene cements of the type mentioned earlier for such surfaces, but they are no better than the thiokol and require much more time to apply.

CONCLUSION

In conclusion, it can be said that the protection from corrosion provided by rubber and synthetic rubber is being recognized to a greater extent than ever before. Such protection more than pays for itself where the item being protected represents an investment, whether it be its intrinsic value or in terms of national security, by reducing maintenance and repair problems of our fighting ships.

Standardizing Parts on DIESEL LOCOMOTIVES

By C. K. STEINS

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RAILROADS which own and operate diesel locomotives built by more than one builder—and most of the railroads fall in this category—find their inventories of repair material swelled because of the lack of interchangeability of parts. This applies mainly to differences between builders and also, to some extent, to locomotives furnished by the same builder.

PARTS INVENTORIES NEED REDUCING

It is not the purpose of this paper to advocate standardizing designs so that a locomotive would lose its individuality. It would not be reasonable to expect the builders to go along with such a program as they no doubt feel that their research and design engineers have developed designs which put them in a better competitive position. There is no thought that this should be broken down. It is believed, however, that there are a large number of items that could be standardized in the interest of reducing the amount of money tied up in the railroads' repair-parts inventories and lightening the burden on the storekeepers as well as facilitating repairs. It is not too late to stimulate thinking along these lines. There are many makes of automobiles but tires, batteries, spark plugs, heaters, and so on, are not special to any one make and most filling stations can usually take care of one's wants.

If the diesel designers had had a manual of standards to refer to, or alternate standards, or recommended practice, no doubt there would be more interchangeability of parts today. Rolled-steel wheels were about the only standardized item when diesel locomotives got into large production and these were not standardized until 1942. Prior to that there were over 400 kinds of rolled wheels. It took the authority of the U. S. Government to boil down these designs to 73 during the war and some of these are temporary standard wheels to be used on existing equipment only. The list of 73 will therefore automatically shrink further.

In recent years there has been a great deal of discussion by railroad groups of the need for standardizing diesel-locomotive parts. The Locomotive Construction Committee and the electrical section of the Association of American Railroads have been active in furthering the idea. The individual railroads have helped themselves in many cases by keeping a certain builder's switcher locomotives in a given territory to simplify the repair-parts problem and, of course, make experts of their maintenance personnel rather than jacks-of-all-trades, but it is not always possible to do this at large terminals.

COUPLER DESIGNS REDUCED TO SEVEN

Owing to the efforts of the Locomotive Construction and the Coupler and Draft Gear Committees of the AAR a list of seven designs of couplers was published in 1952. These were given the status of alternate standards. Had this list been in existence earlier it is probable that we would not have the more than 80 designs of couplers in use on diesels today. One railroad has 43 of them. The seven AAR types were selected to fill all needs. Some of the variety of couplers in use today vary as little as $^1/_4$ in. in shank length; in others the swivel-pin diameter shows a difference of $^7/_{16}$ in.; some have shank wear plates and others do not; and other small differences; but these variations, even though slight, are enough to prevent interchangability. It is earnestly hoped that as new diesels are built selection of couplers will be made from the AAR list. The railroads can help to bring this about when ordering new locomotives.

Consider the item of diesel wheels. These are, for the most part, 40 in. and 42 in. diam., designated Class A-40 and C-42. The wheel fits of the 40-in. wheel are $6^3/_8$ in., $6^7/_{16}$ in., and $6^1/_2$ in. long on existing diesels. In the case of the 42-in. wheel the distance from the inside hub face to the back face of the wheel varies from $1^9/_{16}$ in. to $1^{11}/_{16}$ in. Three of the principal builders vary this dimension on their engines. Because of this situation the railroad shops cannot finish wheels ahead, leaving only the bore for individual fit.

For $6^1/_2 \times 12$-in. friction-bearing switcher-locomotive axles it is necessary to stock at least four rough-turned sizes. Two of these axles have journal collars and two do not; in fact, one builder uses both types. If the railroads expressed a preference in this matter it is probable that the builders would be governed accordingly. There are other differences in these axle blanks, such as the center portion varying from $42^1/_8$ in. long to $43^3/_4$ in., and the length of the combined wheel-and-gear fit portion varies from $12^3/_4$ to $14^3/_8$ in., which probably could be reconciled if recommended standard axles were established. Of course, the railroads could buy a blank big enough for any of these axles but an element in the price is pounds and it also costs man-hours to turn off excess material. Getting down to a recommended axle, or axles, would seem to be a better approach.

SMALL DIFFERENCES PREVENT INTERCHANGEABILITY

An examination of $6^1/_2$-in. and 7-in-diam roller-bearing-journal axles shows not less than 11 blanks for the former and 6 for the latter. Axle loads vary somewhat but as a rule not widely and we have 36, 40, and 42-in. wheels which, of course, are important in stress calculations. There are also different gear ratios. Some of the variations in the detail axle dimensions are quite small and probably could be reconciled and the number of axle blanks the railroads now have to stock could be reduced if the railroads put forward a recommended standard.

It seems reasonable to expect that traction motor gears to produce the same locomotive speed with same size wheels should be the same. In one case an $^{18}/_{75}$ ratio to produce 65 mph with a 40-in. wheel is used, while in another case a $^{18}/_{62}$ ratio is used for this speed with the same diameter wheel. The

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pitch diameters of these axle gears are 29.600 and 27.5556 in., respectively. It appears from this that one design of motor has a larger armature or larger field, or a combination of both, which causes a greater distance from center of motor shaft to center of axle.

One switcher uses a $^{16}/_{75}$ gear ratio to produce a 60-mph locomotive, while another switcher uses a $^{14}/_{68}$ ratio, both with 40-in. wheels. The pitch diameters of the axle gears are 30.000 and 30.2222 in., respectively.

There are other instances where gear ratios and pitch diameters are close. It would simplify railroad maintenance if a way were found to use the same gears with the same wheel diameters for given locomotive speeds. We appreciate what is involved in this from the standpoint of motor design but coordinated designs have been accomplished in the past and possibly could be done with diesel traction motors without sacrificing the individuality of the designers.

Another item in which some standardization should be possible is motor-support bearings. On one group of 24 types of diesel locomotives there are eight designs of support bearings. The OD of these shells varies from $9^1/_4$ to 10 in. Over-all length varies from $10^1/_2$ to $12^1/_4$ in. Collar thickness is $^{31}/_{32}$ to $1^1/_4$ in. There are five lengths of lubrication windows. The bore, except for two bearings, is close, from 8.028 in., min., to 8.280 in., max. Where differences are small it appears not too difficult to lay down designs which all may follow.

A small item, but one that is perplexing to repair forces, is the variety of steam-heat connectors used on diesels. There are at least four lengths of horizontal arms. The problem, as any railroad man knows, is to have the right arm at the right place when a new arm is needed.

UNIFORMITY IN CAB ARRANGEMENTS

There is a need for a uniform placement of controls, seats, and window heights on diesel-switcher locomotives. Road-locomotive cab arrangements are sufficiently standardized so that they escape criticism, at least thus far. The subject is mentioned here not as an inventory item but because it is related to the general idea of standardization. The difficulty with switchers is that crews operate them for a full 8-hr tour of duty, and if one type is less convenient or less comfortable than another, the more comfortable becomes the yardstick and it is not long before the railroad is asked to do something about it. The position of the controls is particularly important because a switcher is operated as much in forward motion as in reverse. There is considerable latitude in placing controls when only one direction of operation is involved but the choice of locations is narrowed down by the reverse operation. It cannot reasonably be said that any cab layout is bad but some are better than others and comparisons are inevitable. It should be possible to review the various switcher layouts, determine which is the best, and give the builders the benefit of a standard plan to follow.

It may be mentioned here that a few years ago it seemed that no one could build a satisfactory passenger-car seat. However, one of the seat manufacturers sat a few thousand people down in a seat that could be adjusted as anyone might desire, and out of these experiments a seat evolved which suited the average person. That is how we build seats today and everyone is happy.

Along with this cab study, it would be well to establish the size and best location for the cab heater.

There are many other items which might be mentioned as possibilities for standardization, such as brake shoes for switchers and road locomotives. There must be a best kind for each service. Standard brake shoes mean standard brake heads. Air compressors might be built so that they can be interchanged, just as many makes of draft gears fit into the $24^3/_8$-in. pocket of freight cars. Lube-oil filter cartridges probably could be of one size; the Locomotive Construction Committee, AAR, we understand, has made good progress with this item. Batteries are one of the bright spots in the picture. Formerly, different kinds of batteries were used, but now that the 64 to 74-volt control is standard for most locomotives, the 32-cell, 425-amp-hr battery is in practically universal use.

CO-OPERATIVE EFFORT

Reference to these matters is not being made in a critical vein. The railroads were many years getting some of the things standard that now make repairs to foreign cars relatively easy, such as draft gears, couplers, coupler yokes, hand brakes, friction bearings, and so on. The first thing to be done is to establish standards by co-operative effort. After that, the situation, at least in so far as new locomotives is concerned, may move gradually in the direction of simplified inventories.

Engineering America's Future

(*Continued from page 22*)

functions. Certainly the Senate career of Ralph Flanders, one of your members, bears me out.

MAKING A BETTER WORLD

Some day, perhaps, the inhabitants of this planet will come to their senses and devote themselves in united human effort to creative good. In such a world, the energies of two and a half billion men and women might be directed at high technical adventure. They might carry out a crash program of wartime proportions against man's enemy, cancer. They might pool their machinery, equipment, skills, labor, and capital to improve the backward areas of the earth. Together they could irrigate the world's deserts, including the one third of our own country that is arid. They might control floods, droughts, and storms, and build an international weather station on Everest. They might explore the world under the sea, drill a second five miles into the earth, and see whether that rocket really can be launched from Earth to Moon.

In the eloquent words Winston Churchill spoke to the English Parliament only recently: "The human race, free from the dread of mass destruction, could have the swiftest expansion of material well-being that has ever been within their reach or even within their dreams. These majestic possibilities ought to gleam, and be made to gleam, before the eyes of the populations in every land, and inspire the counsels of all who take responsibility for their guidance."

I am told that man is the only creature of the earth that is still evolving—that all others have died away or are fixed in their characteristics. Our hope and purpose lie in using our genius to speed up that evolution. Nothing less will serve, for we are in a grim race with evil.

It is not enough that engineers have given us the stunning scientific triumphs that have blessed this land in so many ways. It must be decided now whether or not they will help us to use that science for even better ends. Somehow the nature of man must be made to grow spiritually and intellectually. Somehow our hearts and minds, our morality and our social institutions, must be made to catch up to the technology that the engineer has created for us. I say that this must be done, that it can be done, and that engineers can lead the way in doing it.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

J. J. JAKLITSCH, JR., *Technical Editor*

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Materials-Handling Research

THE Richardson Scale Company, Clifton, N. J., recently unveiled a laboratory staffed with research engineers who are going about systematically inventing and improving materials-handling equipment.

The laboratory, which includes a machine shop, electrical lab, solids-flow lab, and test quarters, has added, since 1952, over a dozen new items to its standard line of materials-handling and weighing equipment, designed a host of special pieces of equipment for special field problems, and built a highly versatile and accurate instrument-control system that is finding a number of applications in the materials-handling field.

Besides this, as a result of its purely theoretical investigations on the flow of solid materials, it is on the verge of discovering some valuable information about the design of chutes, hoppers, and bins.

HOW SOLIDS FLOW

Much is known about how liquids behave in motion; but very little is known about the characteristics of solids in flow.

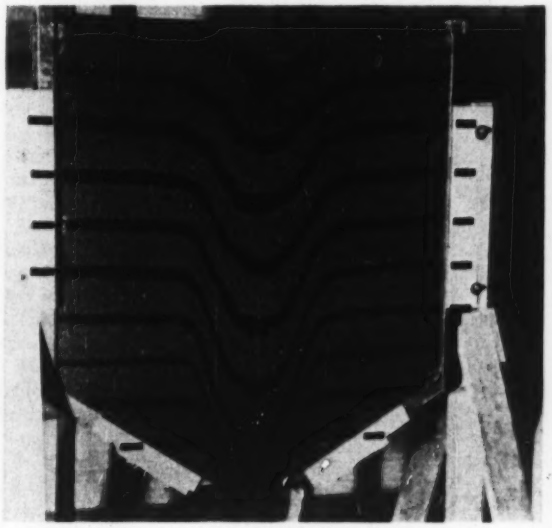

FIG. 1 BIN CROSS SECTION SHOWING FREE-FLOWING PLASTICS MATERIAL IN THE PROCESS OF BEING DISCHARGED

(Photo shows flow commencing in a central core. As a result of such photographic studies, Richardson engineers are convinced that considerations of bin design should be based on the flow of material in this centrally located area.)

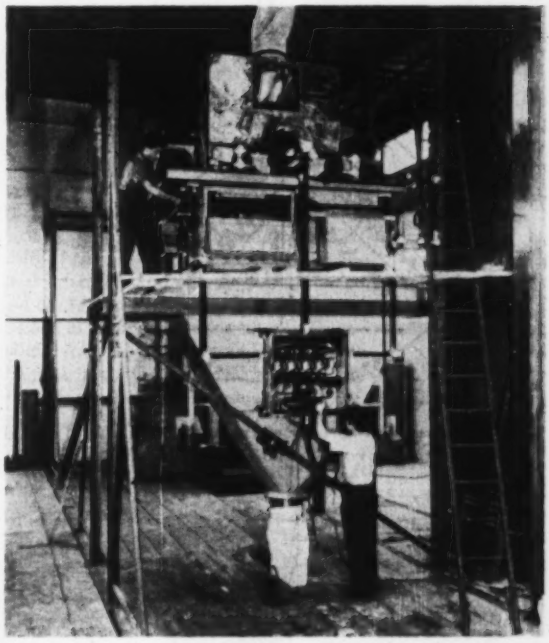

FIG. 2 ENGINEERS PUT FINISHING TOUCHES ON AN AUTOMATIC SCALE, G38 DUPLEX, PRIOR TO TESTING

One of the few groups currently attempting to learn more about solids flow, the researchers are determining and evaluating the factors governing the flow of solids in bins. There is much to learn as available literature on such flow largely is restricted to a few materials in large cylindrical silos, the flow of earth in dams and retaining walls, and occasional bits of information of some materials in a few types of bin configuration.

Thus far, researchers at the lab have collected considerable data on the pressure exerted by different materials on the bin discharge opening. They have also collected information on the lateral and vertical pressures existing at different points within the material mass. It is hoped before long that a general equation may be evolved for flow in any bin of symmetrical shape.

BETTER EQUIPMENT AND CONTROL

The test and development lab has the mechanical facilities and dimensions to work with big equipment under simulated process conditions. Purpose of this lab is to test and improve standard line of equipment and fabricate and test new equipment.

Because of the trend in the weighing field, Richardson is concerned particularly with increasing the speed and accuracy of its automatic weighing equipment. Recently, engineers have been putting their E50 automatic scale through its paces with a

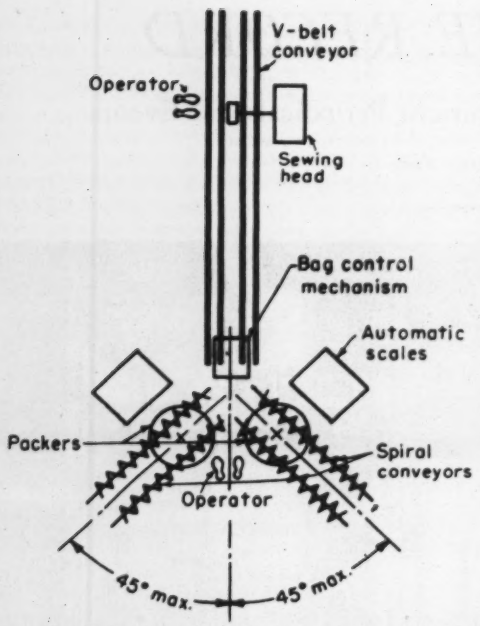

FIG. 3 Y-SHAPED CONVEYER PERMITS ONE MAN TO FILL BAGS OF BULK MATERIALS COMING FROM TWO AUTOMATIC PACKERS

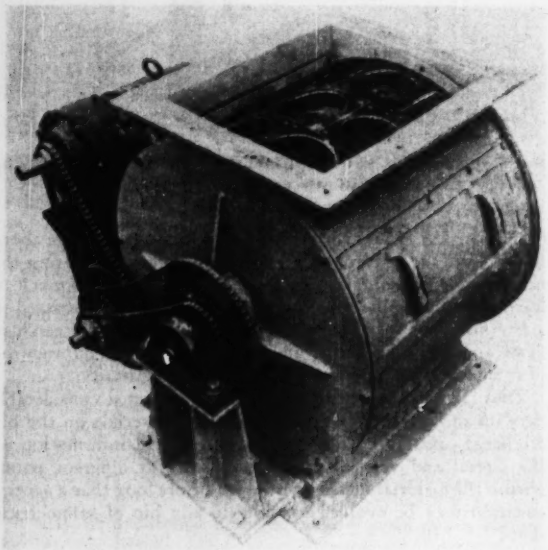

FIG. 4 ROTARY FEEDER FOR HANDLING STICKY OR SLUSHY MATERIALS

(Rubber pockets suck in product, eject it forcibly on discharge.)

high-speed air cylinder used for gate closing. The scale at the same time is being tested for endurance. Each cycle of the high-speed operation is counted, and the scale is run until a breakdown occurs.

Materials-handling equipment in the test lab includes a system of conveyers, elevators, and garners. There are three garners and two bucket elevators feeding them. Capacities are 50 and 25 cfm.

The 25-cfm elevator includes a "Y" spout to feed either of two garners and is designed primarily for customer material. One garner may be used for storage while the other is in use. The garners are located above receiving hoppers, which in turn feed material via a screw conveyer to the bucket elevators.

Shaft of the test elevator is 65 ft high. Materials undergoing test are dropped from gravity chutes above, pass through equipment, and are discharged to a receiving hopper located in a 15-ft pit beneath the floor.

MATERIALS-HANDLING DEVELOPMENTS

Since its completion, the lab has developed several new pieces of materials-handling equipment. They include a giant packer for loading materials in one-ton containers, a Y-veyer that permits one operator to fill bags of bulk materials coming from two automatic packers, a remote-control system for formulating bulk products, and an instantaneous tare-weighing process.

The electrical lab, besides continually fitting standard equipment with up-to-date instrumentation, has developed a synchromechanism that is probably the most accurate instrument of its kind in commercial use today. The Richardson synchros run on 60-cycle and have accuracies of the order of one part in 4000. With these instruments, the company has been able to develop automatic, remote-controlled weighing and formulating processes that have found application in the chemical process, food and dairy, rubber-compounding, and cement and rock-products industries.

Besides developing several original pieces of equipment, the lab has turned out many other materials-handling machines. Some have become part of a new standard line: an automatic

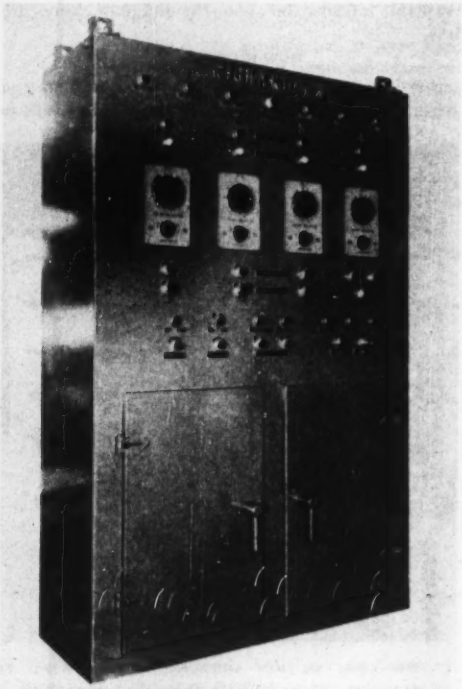

FIG. 5 PANEL BOARD FOR REMOTE-CONTROL BATCH WEIGHING FOR AUTOMATICALLY PROPORTIONING INGREDIENTS FOR DRY CONCRETE MIXES

scale for weighing coal, a screw-fed gross bagger for hard-to-handle hygroscopic materials, an automatic scale that discharges 1000-lb loads, a hand-operated semiautomatic gross bagger, a low-cost cam grip bagholder, a low-power vibrating feeder, a new constant-weight continuous feeder, and a two-headed sewing pedestal for sewing open-mouth bags.

Besides working on new ideas and coming up with new and improved equipment, the laboratory engineers frequently are called on to solve special problems in materials handling that arise in a particular plant and are forwarded to the lab for study. As answers to these inquiries, the lab has designed such pieces of special equipment as a scale for weighing flour on the stream, a continuous proportioning and blending system that consists of an E20 Richardson scale synchronized with a Glengarry scale, and a machine for dumping one-ton cartons loaded by the bulk packer.

Modern London Airport

CONSTRUCTION details of what will be the world's most modern and luxurious airport—London Airport in England—were disclosed recently by British Information Services.

The new $60,000,000 airport will comprise three large buildings: A central control building, due for completion in July, 1955; a passenger-handling building that will be opened in September, 1955; and the eastern apex building (with space for the handling of aircraft operations and crews, and for public amenities such as an exhibition hall and a newsreel theater), which will be ready by January, 1956.

In addition, there will be a new system of runways long enough and strong enough to serve any transport aircraft likely to be operated in the foreseeable future, and three maintenance areas, with rows of hangars for BOAC, BEA, and for lease to overseas airlines.

Cost of the new development will be $58,800,000 of which roughly $42,000,000 had been spent by March, 1953.

The present London Airport, with temporary buildings, was opened for civil aviation on January 1, 1946. It is used by 23 international airlines and last year handled some 845,000 passengers and 2000 tons of mail and freight. These figures are rising steeply, and it is expected that the temporary buildings now in use, which are capable of little further extension, shortly will reach the limit of their capacity.

The busiest airport in Europe, and one of the world's largest international air terminals, London Airport covers an area of 2827 acres south of the Bath Road.

Design and construction of the new development embody the results of many years of study and experiment. Every effort has been taken to insure that the buildings are as handsome as they are functional.

The area reserved for the three new buildings, and their aprons, is 158 acres in extent, and diamond-shaped.

The T-shaped control building is to be situated to the south-center of the inner terminal area. Focal point of the airport will be the control building tower with its highly complex system of radio and line communications, radio and radar navigational aids, airfield lighting, and ground-movement control. These are expected to be the most advanced and comprehensive in the world.

The tower will be 122½ ft tall, high enough to command an all-round view of the runway system, its approaches, and the other taxiway. In its upper stories and in the penthouse will be centered the air-traffic control services. The penthouse will be partly glazed to improve the view upward from the control desks.

In the lower part of the tower, and in part of the wings, the management offices will be situated. The main telecommunications services will be in the east wing. The west wing is planned to house the medical center, with administrative offices; while restaurants and kitchen are grouped in the leg of the T, to the south side.

Opposite the southeast terminal apron, the passenger-handling building will be situated. Here the theme of efficiency combined with luxury is even more in evidence.

How to simplify the complexities posed by the needs of three different types of traveler—those moving from one part of Britain to another, those stopping briefly en route from one country to another, and those entering the country who require clearance through Customs, Health, and Immigration formalities—has been solved by the architect with a design that insures the easy and rapid transit of passengers through the control barriers.

The entire second floor is given over to those entering the country—parallel halls house the concourse, the customs, immigration and health offices, and waiting room. Through each of these run, at right angles, ten separate passenger-handling channels, each with its own baggage-conveyer belt. This means that ten sets of passengers at a time may be passed quickly and easily through the various formalities.

Each of these channels is completely reversible, so that it can handle incoming or outgoing passengers with equal ease. As the peak hours for coming or going traffic rarely coincide, fewer channels are needed, and economy of space as well as of building costs is achieved.

Stretching the whole length of the building is a Customs barrier which cannot be passed by the general public, nor by those in transit, for whom there are facilities in a separate section at the southern end of the building. These include restaurant, showers, a nursery, shops, and cabling facilities.

The first floor is reserved for the handling of baggage, the accommodation of technical staff and equipment, the preparation of food, and other services. Office accommodation for airline companies, a restaurant, and roof gardens, as well as a glassed-in gallery overlooking the landing area, occupy the upper floors.

A roof-bridge connects this building with the eastern apex building adjoining, where aircrews and aircraft operations are handled and public amenities are provided.

The floors and roofs are for the most part precast units, except where they are of reinforced concrete. The buildings are sealed in so far as possible from external noise, and control rooms and offices have double windows. Special acoustical treatments and finishes are used in the control and telecommunications rooms, while absorbent materials tend to reduce the internal noise level in other areas.

Electric Motors

General Electric Company

A NEW line of polyphase a-c motors, offering better protection, more efficiency, and quieter operation has been announced by the General Electric Company's Small Integral and Medium Induction Motor Departments.

Called Tri-Clad "55," the new motors are the result of more than 250,000 man-hours of developmental engineering and research. Built to latest Standard NEMA frame dimensions, they feature many entirely new and advanced concepts of motor design.

With an average size reduction of 50 per cent by volume and averaging 22 per cent less weight per horsepower, the "55" retains rigid cast-iron construction and incorporates a new

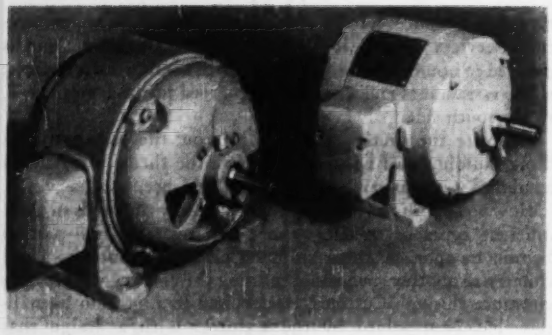

FIG. 6 NEW G-E. LINE OF A-C POLYPHASE INDUCTION MOTORS (*right*) ARE HALF AS LARGE AND AS MUCH AS 40 PER CENT LIGHTER PER HORSEPOWER THAN FORMER MODELS (*left*)

insulation system, bearing assembly, and ventilation plan, according to G-E engineers.

The keystone of the insulation system is a new polyester film which is eight times as strong as previously used materials. It is used to insulate the phases and slot tubes in the stator—the points of hardest motor wear. This synthetic material, combined with Formex wire, an improved Glyptal varnish, and a silicon Dri-film dip, has withstood accelerated life tests and salt-spray tests better than any other system tried, the engineers said.

The new bearing assembly is more tightly sealed and is lubricated by a grease which lasts at least five times longer than formerly used lubricants. A double-end ventilation system uniformly cools the motor by drawing air in from beneath both end shields, through carefully baffled air passages, and out louvers on the sides of the frame. Larger integrally cast rotor fans increase the cooling-air flow through the motor and dissipate rotor heat more effectively. Protection has been increased by 60 per cent on the drip-proof enclosure through new end-shield and frame design.

A major part of the new motor design involves noise levels. In a specially constructed laboratory, G-E engineers sought the causes of motor noise and found a way to reduce over-all sound levels and alter the motor sound to a frequency more pleasing to the human ear. According to the engineers, the noise level of the new 10-hp motor tests as low as the former 2-hp models. All new Tri-Clad motors must now pass a quality-control sound test before leaving the factory.

The totally enclosed fan-cooled motor also has been redesigned. Electrical parts are completely enclosed by tightly sealed cast-iron frame and end shields, a compression-fit lead seal, and a rotating labyrinth seal on the shaft. A new "jet" ventilation system blankets the frame with cooling air. Plastic fan, stainless-steel nameplate, and other exposed parts are corrosion-resistant.

Besides the longer-life lubricating grease, other improved maintenance features include permanently numbered, non-wicking connection leads, a larger diagonally split conduit box, knock-off lugs on the end shields, and location of the combination nameplate-connection diagram directly over the box.

Although size and weight have been reduced materially and new design concepts incorporated, the new Tri-Clad "55" has a higher full-load speed rating and greater efficiency than the former motor, the engineers said.

After the first of the year, the new motors will be available in the 182 and 184 frame sizes (1, $1^1/_2$, and 2 hp at 1800 rpm) in horizontal drip-proof and totally enclosed fan-cooled models, and a complete line of gear motors. Larger frame sizes will become available at regular intervals.

Other types planned for production during 1954 include vertical, single-phase, wound-rotor, explosionproof, multi-speed, face-mounted, and flange-mounted models.

Louis Allis Company

The Louis Allis Company, Milwaukee, Wis., also announced their new line of electric motors in open drip-proof, totally enclosed fan-cooled, and explosionproof enclosures in ratings up to 40 hp at 3600 rpm. These new motors are built in accordance with the new NEMA frame-size standards and the smaller frame sizes will be available to their customers beginning this month.

This new L.A. line features new modern styling, improved ventilation, greater protection, a new conduit-box arrangement, new bearing construction, and more versatile mounting.

The final styling represents motors that are clean-looking and well-proportioned, without sacrificing functionalism to appearance. The basic concept of more power in a smaller, better-looking, job-fitted package is carried out completely.

Utilizing more power in a smaller unit has been accomplished by the use of larger lamination diameters and longer stacking with shorter coil ends. Ventilation, an important factor in motor operation, is more efficient and effective due to better utilization of aerodynamic principles.

The new L.A. line is also lighter and more compact for each horsepower and speed because much of the unnecessary, inactive material has been eliminated. Size and bulk of the cast-iron housing and motor-bearing brackets have been reduced without sacrificing mechanical strength.

As a result of the redesign, the new motor line delivers the same performance as older, bulkier units, with comparable starting and breakdown torque, efficiency, power factor, temperature rise, and service factors.

Bearing construction has been improved. Bearings and shafts have been selected for long life and better overload capacities for V-belt drives. In motors of all sizes, special effort has been made to use bearings that are easily obtainable from local stocks, assuring customer of prompt replacement. Bearings are factory-lubricated with an ample grease-storage reservoir and in normal usage will give years of satisfactory service without maintenance or attention. In addition, grease fitting can be supplied as an optional feature so the user can add grease if desired. Effectiveness of grease seals has been improved to prevent grease leaking out along the motor shaft.

Back-end bearings are locked in place by a bearing cap, and locknuts on the motor shafts minimize end-play. Bearing brackets also have cast-in slots to allow easy removal of bearing brackets for inspection or maintenance.

New motors in the open drip-proof construction now have "single-end ventilation"—cooling air enters at one end, passes entirely through the motor, and exhausts at the other end. This eliminates ventilation openings in the housing and provides a well-enclosed motor suitable for any mounting position.

Both open and closed motors have a new-type split-conduit

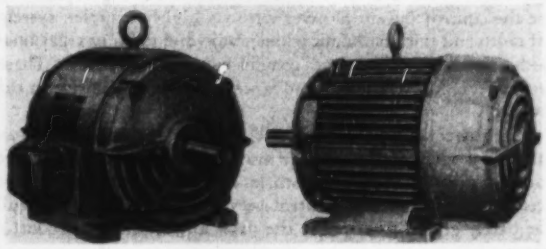

FIG. 7 LOUIS ALLIS INTRODUCES NEW LINE OF ELECTRIC MOTORS

box that separates into halves for easy electrical connection. A lead identification spacer inside the box provides permanent and positive identification of the various leads—even if the lead tags should become lost.

A new, alternate conduit arrangement for the open, drip-proof motor permits omission of the conduit box entirely where the motor must be used in crowded quarters.

Orinoco Iron Mining

WITH operations scheduled to start early in 1954 at the Cerro Bolivar, Venezuela, iron-mine project, the vast engineering achievements involved were reported to the annual meeting of the American Society of Civil Engineers.

The great program of the Orinoco Mining Company, a United States Steel subsidiary, is based on an estimated half-billion tonnage of high-grade ore and an initial annual shipment of 5,000,000 gross tons with provision for expansion to 10,000,000 or more.

William W. Wanamaker, chief engineer of the Orinoco Mining Company, related the discovery of the great deposits in 1947 after aerial photography south of the Orinoco and west of the Caroni Rivers had indicated the existence of a new field.

He said an immense area of high-grade ore runs four miles long and to a maximum width of 4000 ft, with an average ore thickness of 230 ft and a maximum proved ore thickness of 550 ft.

It consists of extremely closely folded ore layers and associated ferruginous quartzite, he added. The average grade is (dry analysis) about 63.50 per cent iron, with the natural-iron content calculated to be about 58 per cent. The iron ore is practically free of sulphur and other objectionable elements. It is a mixture of hematite, limonite, and a small percentage of magnetite.

The hill involved, named Cerro Bolivar in honor of the Liberator of Venezuela, proved up several hundred million gross tons of high-grade iron ore, the ore content of which is somewhat above the average Lake Superior iron ore.

Cerro Bolivar lies 88 miles from the junction of the Caroni and Orinoco Rivers, which, in turn, is 154 nautical miles from tidewater. From the mouth of the Cano Macarea (tidewater) to the Fairless Works at Morrisville is 2004 nautical miles, and to Mobile is 2135 nautical miles. Studies indicated the ore could be delivered at these ports in competition with Labrador ore and Lake Superior taconite and that on a proper basis Venezuelan ore should find markets in the Gulf area, on the East Coast, and in the Pittsburgh and Youngstown areas. Accordingly, United States Steel planned to develop this ore body and to ship initially at the rate of 5,000,000 gross tons annually, with provision for expansion to 10,000,000 or more tons annually.

The ore, which is practically free of overburden and in some respects is an outer shell of the mountain, he disclosed, is to be mined with power shovels, loaded into trucks, and dumped into railroad cars at the top of the hill. Single-rail tracks are being constructed to Puerto Ordaz, junction of the Orinoco and Caroni.

There the ore will be crushed and loaded into ocean-going vessels at dockside. Suitable docks, service and maintenance facilities, towns, and utilities are being provided. Ocean-going vessels will reach the port, about 154 nautical miles inland, by a channel 26 ft deep at low water. He said further that the mining operation will be the reverse of normal open-pit mining; i.e., the top of a mountain and a good proportion of its side slopes will be excavated, rather than digging in the earth below ground levels. The uppermost ore is at elevation 775 meters. Large tonnage lies above the 700-meter contour. Ore lies down the mountain even below the 600-meter contour, which, in turn, is still 300 meters above the base. Trucks and rail cars will be running downhill under loads. Accordingly, braking action is of paramount importance.

Radio Corporation of America, he said, has designed and installed for the company a high-frequency radio system for Caracas, Cuidad Bolivar, Puerto Ordaz, Cerro Bolivar, and the route between the mine and tidewater.

By locating the crushing plant and ore-handling system at Puerto Ordaz, it is available for handling the ore from deposits other than Cerro Bolivar, he said.

Outstanding or unusual features of the ore-handling system, he recounted, are its enormous designed capacity of 1.67 tons of ore per second; size and speed of the car dumper, probably the most rugged, considering weight of loaded cars and time cycle, ever built; massive primary gyrater crusher; reclaiming tunnels under the stockpile; continuous sampling system; avoidance of hoppers and use of apron feeders with transfer belts to provide for more uniform belt loading and better operating characteristics; use of d-c variable voltage system from reclaiming tunnels to shiploader so as to provide a completely interlocked, variable speed, operation.

Towns are being constructed at port and mine. Housing includes the row-type for general workers; detached houses for white-collar workers; and staff houses. They are concrete block, single-story, with concrete floors and flat concrete roof with asphalt felt paper and stone chip covering. The three types vary in floor area.

Air-Borne Concrete

A PUSH-BUTTON system of blowing concrete by compressed air through pipe from underground mixing stations into construction forms has been installed by The International Nickel Company of Canada, Ltd., at its Creighton Mine. This system of utilizing air-borne concrete is greatly expediting the company's program of mining by induced caving.

To stabilize areas of the mine worked and abandoned 40 or more years ago, and utilize old openings in which the timber supports have rotted and collapsed, extensive concreting is necessary. Very slowly and often only with the greatest difficulty could concrete be delivered to these locations until the push-button system of blowing it there by compressed air was installed.

Several thousand bags of concrete a month are now being used underground at Creighton to build slusher stations and drifts, boxhole brows, switchrooms, and other installations required to meet the caving project's quota of 12,000 tons of ore per day.

Concrete mixing stations are located on the 6th and 20th levels. Gravel for the concrete is received at the mixing stations by gravity from surface through a raise formerly used for bringing rock fill to the various levels of the mine. Control chutes have been installed in the raise for handling the gravel at each station. Cement is brought from surface by the mine's regular transportation system.

Located in large rooms which provide ample space for cement storage, the mixers can produce a 16-cu ft batch of concrete every three minutes. It is poured into the placer, a cylinder $2\frac{1}{2}$ ft in diam $\times$ 10 ft long, into which compressed air is then introduced from the mine's main air line.

From the placer the air-borne concrete is blown through a line of 6-in. steel pipe which carries it along levels, up or down manways, and through twists and turns of the mine's workings until finally, perhaps a quarter of a mile or more from the mix-

ing station, it drops right into the forms at the construction site.

At 90-deg turns in the line T-bends are used; an air cushion which forms in the dead end of the T greatly reduces abrasion from the concrete. On long curves sections of 8-in. pipe are inserted, with Ni-Hard liners; standard steel elbows last as little as two hours under the impact of the concrete at these turns but the Ni-Hard liners, made of a very tough nickel alloy, were unchanged after six months of operation.

Operation of the concrete placers has resulted in the following performances: Best "up" delivery so far was a total of 1315 ft from the 20-level placer, consisting of 875 ft on 20 level, up 210 ft on a 47-deg incline, 100 ft on the level, up 50 ft at 90 deg, and finally 80 ft on the level. The 6-level station takes credit for the longest "down" delivery to date, a total of 1670 ft from the placer into the forms for a new slusher station on 14 level.

300-Hp Gas-Turbine Locomotive

THE development of a 300-hp, 30-ton, dual-gas-turbine locomotive has been announced by the Transportation Corps, Department of the Army. Suitable for both light road and switching service, this locomotive will be the first to be built with mechanical drive. Twin-turbine arrangement is used for the purpose of improving fuel consumption.

The locomotive will be designed and built by the Davenport Besler Corporation, Davenport, Iowa, as a subcontractor of the Boeing Airplane Company. Completion of the locomotive is scheduled for June, 1954, at which time it will undergo extensive engineering and railway tests to determine its characteristics and performance and to enable the Transportation Corps to become familiar with the problems involved in such an application of the gas turbine.

Some of the general details of the locomotive follow: Nominal weight, 30 tons; maximum weight, fully loaded, 58,000 to 60,000 lb; maximum weight, per axle fully loaded, 25,000 lb; (on driving axles, 25,000 lb; on guiding axles, 5000 lb); locomotive length, over bumpers, approximately 25 ft; locomotive width, over-all, maximum 9 ft; locomotive height, top of rail to top of cab, approximately 11 ft 2 in.; track curvature, locomotive alone, minimum 75-ft radius; track curvature, coupled minimum 100-ft radius; wheel arrangement, 2-4-2; speed, 35 mph; fuel capacity, 250 gal.

The power plant will consist of two Boeing Model 502 gas turbines with top rating of 175 hp each; an Allison torquematic, 3-speed transmission; a Davenport 4030 transmission for reversing; and Westinghouse pneumatic controls with governor—provision made for use of one or both engines depending upon load demand.

Westinghouse automatic air brakes plus an emergency hand brake will be included.

First details of this new gas-turbine locomotive were presented to a meeting of the General Technical Committee of the ASME Gas Turbine Power Division during the 1953 ASME Annual Meeting in New York, N. Y.

Indexing System

INAUGURATION of a field-test program for a new system of indexing and retrieval of information was announced by the Defense Department's Armed Services Technical Information Agency. The new system, known as Unitern Coordinate Indexing, was developed by Documentation, Inc. of Washington, D. C., under the contractual sponsorship of ASTIA. Savings of up to 90 per cent in present catalog space and up to 75 per cent in present cataloging time is indicated as well as better effectiveness in retrieval of pertinent information.

In addition, the ASTIA test program has important defense implications. More effective methods of indexing the thousands of technical reports generated by defense research and development will make it possible to organize and store for instant application the technical and scientific "know-how" the United States is acquiring through its intensive research program.

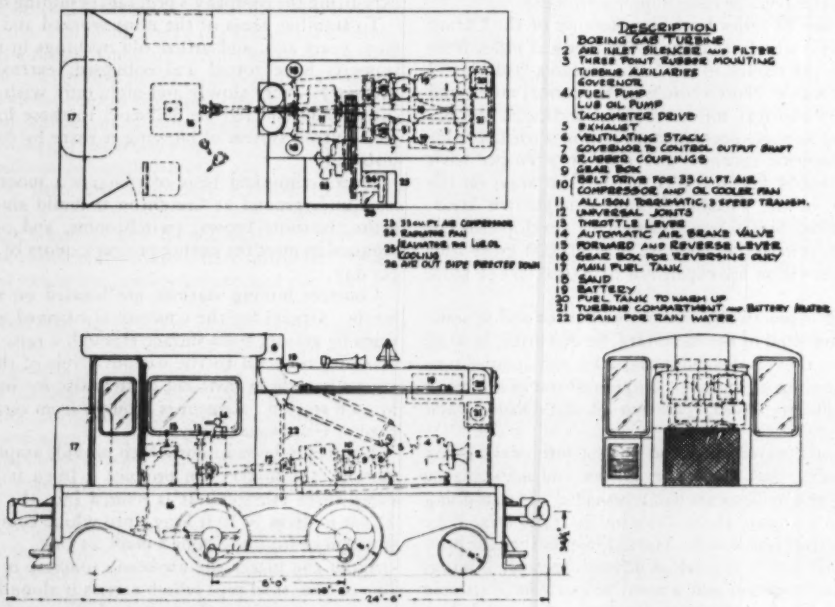
DESCRIPTION
1 BOEING GAS TURBINE
2 AIR INLET SILENCER AND FILTER
3 THREE POINT RUBBER MOUNTING
4 TURBINE AUXILIARIES GOVERNOR, FUEL PUMP, LUB OIL PUMP, TACHOMETER DRIVE
5 EXHAUST
6 VENTILATING STACK
7 GOVERNOR TO CONTROL OUTPUT SHAFT
8 RUBBER COUPLINGS
9 GEAR BOX
10 BELT DRIVE FOR 33 CU FT. AIR COMPRESSOR AND OIL COOLER FAN
11 ALLISON TORQUMATIC, 3 SPEED TRANSM.
12 UNIVERSAL JOINTS
13 THROTTLE LEVER
14 AUTOMATIC AIR BRAKE VALVE
15 FORWARD AND REVERSE LEVER
16 GEAR BOX FOR REVERSING ONLY
17 MAIN FUEL TANK
18 SAND
19 BATTERY
20 FUEL TANK TO WASH UP
21 TURBINE COMPARTMENT AND BATTERY HEATER
22 DRAIN FOR RAIN WATER

FIG. 8 DIAGRAM OF 300-HP, 30-TON EXPERIMENTAL GAS-TURBINE LOCOMOTIVE

The Unitern System of Coordinate Indexing is a step in the direction of information storage and retrieval by machine methods. Already under development for use with the Unitern System is a completely automatic indexing machine which will present the document numbers in answer to reference questions typed out on a conventional typewriter keyboard. The System has potential uses in many fields such as supply cataloging, patents' literature organization, film cataloging, record keeping, and many other such forms of information control of a particularly difficult nature.

With the Unitern System of Coordinate Indexing, all words in the language are treated as equal terms for indexing purposes, regardless of parts of speech, and are joined as phrases in answer to questions by the searcher. For example, all information on guns is recorded by its identification number on a catalog card labeled "guns" and all information on aircraft is recorded on a card labeled "aircraft." When identifying numbers are found to be common to both cards, the corresponding information pertains to "aircraft guns." Still a third card may be labeled "air-cooled." Numbers in common to all these cards indicate information on "air-cooled aircraft guns."

In describing information on air-cooled aircraft guns for the conventional catalog, the indexer faces the choice of six forms of catalog entry; i.e., air-cooled aircraft guns; aircraft guns, air-cooled; guns, aircraft air-cooled; air-cooled guns, aircraft; guns, air-cooled, aircraft; aircraft-air-cooled guns. The cataloger might use all six to be sure the searcher will find what he wants; otherwise the searcher must determine which form of entry was used. The result is an unnecessarily large and complicated catalog—time-consuming and expensive to construct and maintain; or filled with uncertainty from the viewpoint of both the indexer and searcher.

The intentional formlessness of the Unitern System makes it possible for the searcher to consult the catalog any way he pleases and at the same time gives him assurance of a complete search at once without having to refer to a number of different places in the catalog. Further, by not having to make subjective decisions as to form of expression or entry, the indexer can effect a depth of analysis, hitherto impractical, in far less time than even a shallow analysis can be accomplished by conventional means. Equally important, the size of the catalog is reduced dramatically by virtue of the fact that it is dependent on the size of the vocabulary rather than the vast number of word combinations contained in the language. Analogous to this is the number of chemical compounds compared to the number of chemical elements; or the vast number of words derivable from combinations of the 26 letters in the alphabet.

The launching of this field test of the Unitern System marks an important step in the continuing ASTIA research program designed to achieve greater economies and increased effectiveness in the cataloging of the many thousands of defense technical reports it is charged with handling for the Department of Defense.

Optical Gaging

GEAR analysis can now be accomplished visually by optical gaging methods with a new gear analyzer recently announced by Optical Gaging Products, Inc., Rochester, N. Y. Direct observation of a magnified gear image allows inspection, analysis, and gaging of the gear under simulated operating conditions. Need for interpolative data is said to be eliminated. The gear analyzer will check the following: (1) Involute profile, (2) fillet interference (or clearance), (3) outside diameter, (4) root diameter, (5) pitch diameter, (6) backlash (effective tooth thickness at standard pitch diameter) by (a) center-distance and (b) slap between teeth, (7) tooth-to-tooth spacing (circular pitch), (8) modified tooth form, (9) tapered teeth, (10) tooth crowning, (11) first and last contact points, and (12) off-axis teeth (asymmetrical).

FIG. 9 OPERATOR SEES GEAR IN RELATION TO BASIC RACK-CHART GAGE

According to OGP, this gear analyzer checks a wide range of gear sizes—and no master gear is required. Complete analysis of "running conditions" can be made, even when gear operates with backlash.

The OGP gear analyzer works on the following principles: The gear is viewed as it rotates in contact with—and at the correct center distance from—a composite rack chart (e.g., 14 to 180 DP). Thus analysis of the gear is made by observing the "running action" at a magnified projection on a Model 3 Kodak contour projector. The various elements of the gear are all visual and can be quickly gaged or analyzed with the OGP gear analyzer.

NBS-AEC Cryogenic Laboratory

A MAJOR low-temperature engineering facility, consisting of a liquid-hydrogen plant and a cryogenic laboratory, has been placed in operation at the National Bureau of Standards site at Boulder, Colo. Known as the NBS-AEC Cryogenic Engineering Laboratory, the new $3,500,000 installation makes possible large-scale production of liquefied gases which previously have not been available in sufficient quantity for laboratory and industrial development and testing.

The Cryogenic Engineering Laboratory was initiated and designed, in co-operation with the Atomic Energy Commission, to provide facilities needed for the development and evaluation of cryogenic equipment for use at temperatures near absolute zero. The Bureau's long-standing program of fundamental

research on the properties of liquid helium, superconductivity, second sound, paramagnetism, and other phases of low-temperature physics remains at the NBS Washington laboratories.

Low-temperature activities at Boulder are carried on by a staff of 60 NBS personnel. Besides the production of liquid hydrogen and liquid nitrogen in unusually large quantities, a program of research and development, directed chiefly toward the improvement of low-temperature equipment, is well under way.

Low-temperature liquefied gases—oxygen, hydrogen, and nitrogen—are finding increased application in industry and national defense, making necessary larger, more convenient, and less hazardous equipment for producing and handling these liquids. As a result, many new and highly complex engineering problems have arisen in the low-temperature field, where much remains to be learned about the behavior of engineering materials. At liquid-hydrogen temperatures, normally trustworthy construction steels become brittle, rubbers lose their elasticity, and the mechanical properties of plastics are altered greatly. In general, there are such marked differences between the behavior of matter at ordinary and very low temperatures that the low-temperature properties cannot be obtained by extrapolation. The NBS-AEC Cryogenic Engineering Laboratory is investigating structural and other engineering properties of matter at low temperatures to provide the needed data and is developing more satisfactory materials and equipment for low-temperature use.

The Boulder installation is located on a 210-acre tract, the site also of the Bureau's large radio propagation laboratory now under construction. It consists of three principal units: A liquid-hydrogen plant, a liquid-nitrogen plant, and a group of laboratories for research and development. Two large concrete buildings—one housing the liquefying plants and the other for the experimental laboratories and shop—provide a total floor space of 34,000 sq ft. There are also several auxiliary buildings and test sites.

Both major buildings are equipped with many safety and antiexplosion devices to minimize the hazards of working with liquid hydrogen in large quantities. The hydrogen liquefying and purifying equipment, which was designed and constructed by NBS, is in duplicate so that the plant can be operated continuously without shutdown. The experimental laboratories have been designed with emphasis on versatility in order to make possible continuing research in a variety of fields of science and engineering as the need arises.

Research and development at the NBS-AEC Cryogenic Engineering Laboratory are directed primarily toward safer and more convenient means for handling liquid hydrogen and toward increased knowledge of the properties of materials at very low temperatures. Efficient design of low-temperature equipment requires information on the mechanical and heat-conducting properties of many metals, alloys, and plastics over a temperature range extending from room temperature down almost to absolute zero. The Bureau is now developing apparatus for low-temperature measurement of the tensile and impact behavior and fatigue properties of these materials. Such data are at present very meager and are confined mainly to those materials and temperatures encountered in aircraft design. As a first step toward the accumulation of thermal-conductivity data, apparatus has been designed which provides results in the temperature range from 2 to 300 K. The new apparatus is expected to make possible more rapid collection of data without loss of accuracy.

Design of a large-capacity cryostat is also under way. This equipment will be used to provide a controlled-low-temperature environment for many different kinds of tests of low-temperature materials.

The Bureau is also working on the design of more efficient insulated lines for transfer of liquefied gases. A major part of this project is the development of valves, fittings, and couplings that will permit easy assembly, extension, and control of flow.

Recently the efforts of the Bureau to obtain liquid para-hydrogen on a large scale have met with signal success. Liquid hydrogen as usually produced has a high concentration of the molecular form known as ortho-hydrogen, in which the diatomic molecules have the two nuclear spins oriented in the same direction. But the low-temperature equilibrium form of hydrogen is nearly pure para-hydrogen, in which the nuclear spins in each molecule are opposed. Thus ordinary liquid hydrogen slowly changes to the para form with an accompanying evolution of heat, and this heat causes a serious loss of liquid hydrogen by evaporation (about one per cent per hour for fresh normal liquid hydrogen). One of the liquefiers at the Cryogenic Engineering Laboratory has been equipped with a special catalyzing chamber which results in the production of almost pure liquid para-hydrogen. This liquid hydrogen, being free of exothermic ortho-para conversion, has excellent keeping qualities ahd can be stored with little loss for many days.

Thimble-Size Transistor

A THIMBLE-SIZE power-type transistor that is 100 times as powerful as present commercial available types has been developed by Minneapolis-Honeywell Regulator Company. Described as a major contribution to the advancement of transistors, the new power unit already has been incorporated into a prototype aircraft electronic fuel gage but is not yet in commercial production, being built on a pilot-line basis.

The new transistor's output of 20 watts contrasts with that of 0.20 watt for present commercial types of the electronic midgets that are replacing vacuum tubes in many applications.

This greater power is said to enable it to be used in the operation of motors, valves, relays, and other equipment.

The inability of transistors to handle sizable amounts of cur-

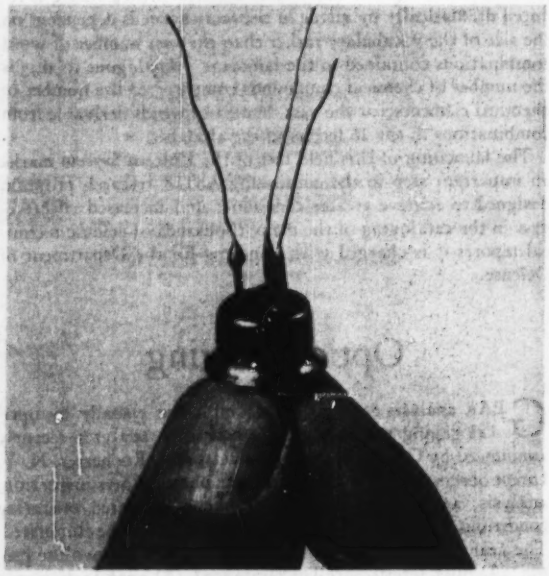

FIG. 10 THIMBLE-SIZE, POWER-TYPE TRANSISTOR

rent has been a major drawback and one that many researchers in the electronics industry have been trying to overcome, with the problem of heat being the big stumbling block. The key to M-H development of its power-type unit was the discovery of an effective means of removing heat from the germanium-alloy junction.

J-44 Turbojet

GUIDED missiles with Fairchild J-44 turbojet engines have been fired regularly during the past three years, according to an announcement by Fairchild Engine and Airplane Corporation, Farmingdale, N. Y. Representing an entirely new concept in gas-turbine design, the Fairchild power plant is the last American jet to have security restrictions among those in production throughout the Korean conflict.

Details revealed earlier this year identified the J-44 as the jet power plant in the high-speed, high-altitude Ryan Firebee, America's newest pilotless plane, a joint project of the U. S. Air Force, Army, and Navy.

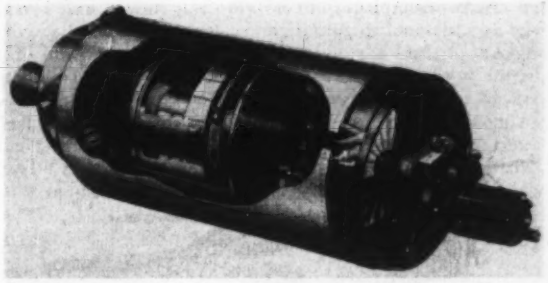

FIG. 11 CUTAWAY VIEW OF FAIRCHILD J-44 TURBOJET GUIDED-MISSILE POWER PLANT

The J-44 features an outer sheet-metal cowl which forms both a pressure chamber and a frame structure connecting the two main bearing supports, reducing the turbojet engine to its basic structural requirements. Currently in production for target drone and missile applications, the jet is said to provide more power in ratio to weight and compactness than ever before attained.

In the 1000-lb thrust power class and weighing 300 lb, the engine is 72 in. in length and 22 in. in diam.

Meteor-Camera Film

ONE of the operating secrets of a highly efficient new meteor camera being used by Harvard College Observatory is photographic film molded almost into the shape of a bowl.

The telescope-camera is being used by Harvard astronomers on a Navy project to learn more about the earth's upper atmosphere. Because meteors perform like bullets and other projectiles, the studies are expected to prove useful to the armed forces in high-altitude rocket experiments.

In 1947 Harvard began experiments on the design of a new Super-Schmidt telescope-camera on a contract with the U. S. Navy Bureau of Ordnance. They consulted Kodak Research Laboratories on the film problems involved. Unique design of the instrument, manufactured by Perkin-Elmer Corporation, Norwalk, Conn., required a curved field to provide the fastest possible speed. Special shaped film was needed to record accurately the tracks of meteors as they race through the sky.

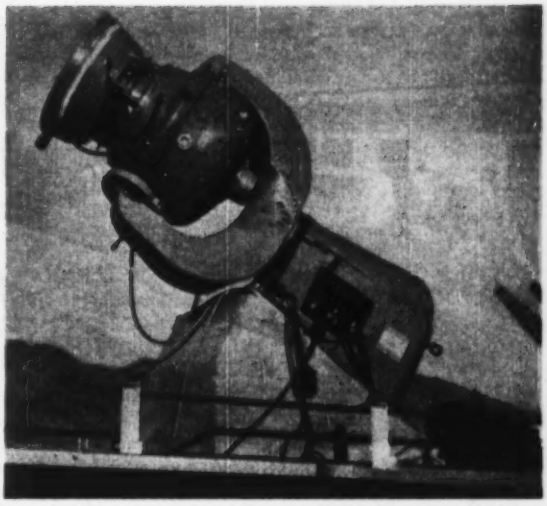

FIG. 12 A NEW 5000-LB CAMERA OF THIS TYPE NEAR LAS CRUCES, N. MEX., PHOTOGRAPHED 56 METEORS IN A PERIOD WHEN AN OLDER CAMERA RECORDED ONLY ONE

Kodak emulsion-research scientists and engineers in the company's manufacturing experiments division tackled the problem. They soon learned they had a puzzle on their hands.

Coating emulsion on premolded glass base was possible, but prohibitively expensive, so molding sensitized film seemed to be the answer. But good molding conditions demanded high temperatures and long molding time— on the other hand, low temperatures were required to preserve the delicate film emulsion, and a short molding period was needed to prevent film fogging.

The problem was solved by compromise. Test molds were made to determine the highest temperatures and longest molding time that could be used without damage to the sensitive photographic film. Then experimental equipment was devised by the researchers with provisions for rapid heating and cooling of the mold.

Samples of shaped film were sent to Harvard for testing. They proved satisfactory, and after making minor changes, Kodak turned over molding data and equipment plants to Harvard Observatory. Later use of similar equipment at Harvard suggested major improvements which have since been added.

Two of the huge 5000-lb meteor cameras are located at Harvard's meteor stations near Las Cruces, N. Mex. Now being operated under contract with the Office of Naval Research, they serve as the main instruments in Harvard's photographic meteor program which has been in progress since 1936.

Possibly the best demonstration of the usefulness of these cameras for photography of meteors is the performance of the first camera, while it was operating on the same sky region, with one of the earlier meteor cameras, according to Dr. Fred Whipple, director of the meteor program. During this period the Super-Schmidt photographed 56 meteors. Only one of these was caught by the older camera.

Meteors, mostly fragments broken off minor planets or comets, and sometimes no larger than buckshot, are being photographed by the Harvard scientists as a part of their sky survey.

The cameras are extremely fast (f 0.67), with a wide enough field to cover at one time an area 10,000 times the size of the moon.

FIG. 13 RAILROAD LOADING AND UNLOADING PLATFORMS OF THE FUTURE MAY HAVE SPEEDWALK SYSTEMS TO TRANSPORT RIDERS AND LUGGAGE TO AND FROM COACHES AND SLEEPING CARS

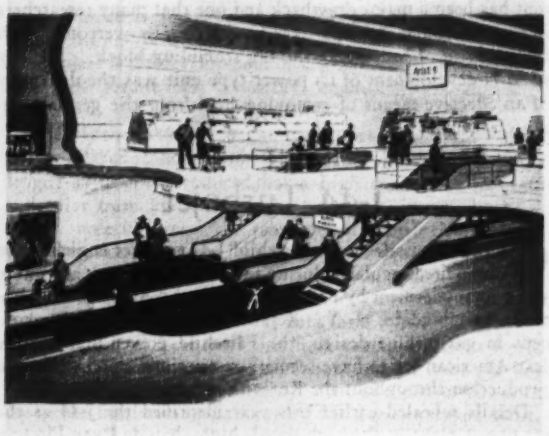

FIG. 14 SPEEDWALKS USED IN HUGE SHOPPING CENTERS WOULD MOVE CUSTOMERS FROM PARKING SECTIONS TO A MAIN-LINE SUBWAY CONVEYER BELT TO BE CARRIED TO VARIOUS STORES AND SHOPS

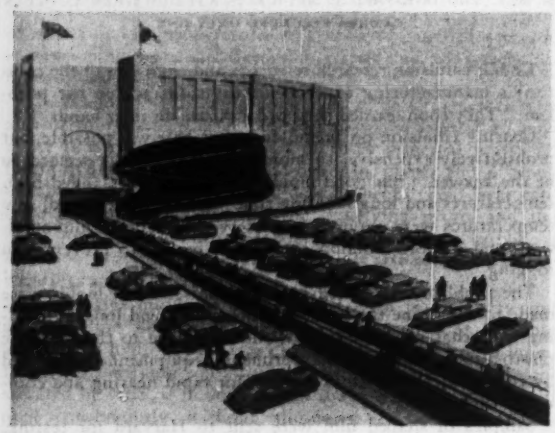

FIG. 15 GOODYEAR ENGINEERS HAVE PRODUCED A MASTER DESIGN FOR INSTALLING SPEEDWALK SYSTEMS IN ANY HUGE PARKING AREAS SUCH AS ARE FOUND AT RACE TRACKS AND ATHLETIC FIELDS

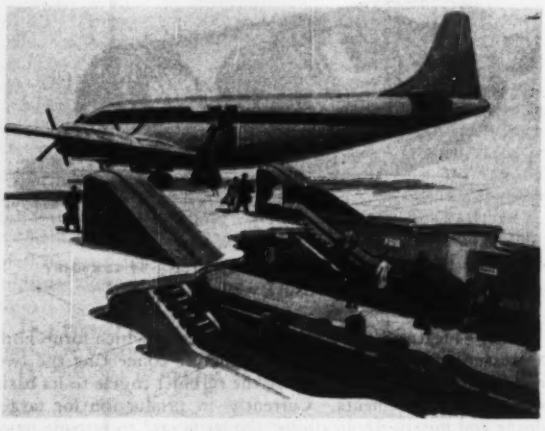

FIG. 16 ARTIST'S CONCEPTION OF SPEEDWALK FACILITIES IN THE AIR TERMINAL OF TOMORROW SHOWS PASSENGERS AND LUGGAGE BEING MOVED TO AND FROM PLANES BY CONVEYER BELTS

Passenger Conveyers

PASSENGER-CONVEYER belts are fast becoming a reality, according to engineering studies carried on for five years by Goodyear Tire and Rubber Company and Stephens-Adamson Manufacturing Company, Akron, Ohio.

The two companies have designed and tested all phases of a passenger-conveyer-belt system to replace the Grand Central-Times Square Shuttle in New York City (MECHANICAL ENGINEERING, June, 1953, page 493). Prospects for installation at the present hinge on improvement in the city's financial position. Col. S. H. Bingham, Mem. ASME, general manager of New York's vast transit system, is originator of the idea for the conveyer system.

Contract to build the world's first passenger-conveyer-belt system, a 227-ft Speedwalk, has been awarded to Goodyear and Stephens-Adamson by the Hudson and Manhattan Railroad Company. It will be installed in the ramp portion of the connecting tunnel between Erie station and the Hudson and Manhattan tubes at Jersey City, N. J.

Meanwhile, engineers for the two companies are creating designs for passenger and baggage transport by belt in one of the world's biggest airports, a plan for loading and unloading passengers by conveyer belt in railroad and bus terminals, a complete belt system for all transportation in a gigantic shopping center in the east, and a master design for handling foot traffic in any extensive parking area.

Under consideration also are passenger-belt systems for race tracks, ball parks, football stadiums, and other places where the continuous flow principle of conveyer belts can solve congestion problems.

With continued growth of air terminals, the trend toward large supermarkets in expanding suburban areas, growing length of passenger trains, and increasing size of off-street parking areas, both Goodyear and Stephens-Adamson have stepped up their development program on passenger-conveyer belts to an all-out basis.

Electronic Data Processing

ELECTRONIC computers, originally designed to help win wars and to solve intricate scientific mathematical problems, are successfully invading the large business-machines market, according to the November, 1953, issue of *Research for Industry*, Stanford Research Institute bulletin.

More than one and one half billion dollars worth of adding, accounting, and other business machines were sold in the U. S. last year. Every one of the principal manufacturers of these office machines is engaged in research and development on new electronic equipment which will replace their mechanical models to some degree.

No longer are electronic accounting machines thought of as "computers" but as "data processors" which can handle many types of information flowing through a business.

TECHNO-ECONOMIC APPROACH

SRI's studies have shown that replacement involves systems study, machine design, and equipment evaluation. All accounting operations of a company must be planned and integrated into a unit, not only on the organization charts but physically or through connecting wiring or long-distance teletype lines. In computer programming, the logic of machine design is determined so that the data may be received, sorted, collated, filed, processed, and printed in efficient order by electronic methods and be readily available at all times. Economic and technical information accumulated is evaluated to determine if machines or parts to construct a machine are available, or if an entirely new electronic data-processing unit must be built.

COMPUTER APPLICATIONS

Numerous and diverse applications of electronic information handling are under study by SRI's staff in the field. Among these are systems for maintaining inventory figures in magnetic form on a spinning drum. Any item among 10,000 can be checked as to quantity on hand or on order, sales activity, or other facts, in less than one second. An installation at American Airlines in New York is indicative of the versatility of electronic equipment in handling clerical and accounting data. The inventory of available seats on 1000 airplane flights is set up so that when a ticket is sold the seat is erased from the magnetic memory. If it is canceled it can be reinstated in proper order.

Inasmuch as a large portion of the data of a business originates in its own operating departments, SRI researchers have found it desirable to consider the application of electronics to the shop and the office simultaneously. The chemical and power industries have made some advances in this direction. Notable among these is the use by the Boise City Oil Company of a telephone control system over a booster pump station located 62 miles away. The dials at the pump site send back dial telephone impulses indicating conditions at the site; instructions are transmitted to the station over the same line and electronically put into action. Personnel inspections need not be made more than once a month. Much of the control of chemical processing is done more effectively by electronic rather than by other means as, for example, the use of closed-circuit TV observations at remote or dangerous locations, which can be viewed on a screen in the supervisor's office. Data from dials and gages can be punched automatically into tabulating cards and processed into reports without the use of clerical recording.

Electronic computers have been credited with the ability to think. They can follow an intricate series of instructions and make a choice between routines, depending upon whether a result is more or less than a given figure. This ability led to the thinker reputation. However, computers are relatively tireless and infinitely faster than the human brain or any mechanical machine. The speed and efficiency of handling data on punched cards is well known, but it is revealing that figures can be handled electronically at more than 1000 times the speed of conventional punched card processing equipment.

Plastic Truck Bodies

PRODUCTION of truck and trailer bodies constructed of Vibrin polyester resin, made by Naugatuck chemical division of U. S. Rubber Company, and glass fiber, has been announced by Seaboard Transportation Company of Antioch, Calif.

To date the largest plastic trailer bodies built by Seaboard are 24 ft long, 8 ft wide, and 8 ft high. This particular size is the one most commonly used by the company, which operates more than 300 heavy-duty trucking units, capable of carryng any type of load, in California, Oregon, and Washington. These units are used in "trains," consisting of a tractor and two semitrailer combinations, with a gross over-all weight of 76,800 lb, maximum permissible in coast states. The equipment is subjected to extremely heavy usage in all types of weather conditions and temperatures, from the desert areas in California to the snow and ice-covered mountains of the northwest.

Construction of the plastic trailer bodies is not complicated. The material is molded in wood, steel, and plastic molds by "laying-up" the fiberglass cloth and mat, cut to rigid specifications, following which it is saturated with Vibrin polyester resin.

As the process proceeds, preformed ribs, made of the same material, are pressed into the wet lay-up ultimately forming a complete section, the parts of which, when cured, become one integral unit.

The bodies are made in four sections—two sides, the roof, and front section. The space at the rear, of course, is used for doors. After each section is completely cured the four are assembled, and bonded together by resin and mechanical means, on conventional trailer chassis. Smaller truck van bodies have been made in one mold.

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources: i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Frequency-Response Symposium

THE following papers, contributed by the Dynamic Systems Committee of the ASME Instruments and Regulators Division and presented at the 1953 ASME Annual Meeting, attempt to cover the major aspects of the frequency-response approach in its present form. Individual copies of the papers are available to nonmembers at 50 cents each; to members at 25 cents each. In addition, the 16 papers, bound under one cover, are available to nonmembers at $5 per copy; to members at $4 per copy.

Frequency-Response Data Presentation Standards and Design Criteria, by Rufus Oldenburger, Mem. ASME, Woodward Governor Company, Rockford, Ill. 1953 ASME Annual Meeting paper No. 53—A-11 (in type; to be published in Trans. ASME).

THIS paper gives standards for the presentation of frequency-response data. The standards are recommended by the ASME-IRD Dynamic Systems Committee to facilitate the exchange of information directly and through the medium of publications. The Committee recommends that magnitude curves be plotted on logarithmic co-ordinates, and phase on the linear scale versus frequency on the log scale. Further recommendations involve transfer functions, measurements, nonlinearity, ambient effects, and other factors.

The paper was written with the technician in mind, as well as the automatic-control engineer and scientist. For this reason, the reader with little or no mathematical background is carried as far as possible into the theory of the frequency-response field. Basic design criteria, in common use, as well as others, are given, and it is shown that control design, as far as dynamic performance is concerned, can be reduced, at least in rough analyses, to simple properties of curves that may be either theoretically or experimentally obtained. From the slope of one such curve the designer can often say whether or not a controller will be stable when placed on the system to be controlled.

It is hoped that this paper will enable as many readers as possible to start on the scientific design of controls and, where they do so, to use the standards here recommended. It is not implied that the reading of this paper is a substitute for a knowledge of some of the vast body of mathematics on which it is based. One objective of the paper is to give management, at least technical management, some insight into how automatic controls can be designed scientifically.

The paper concludes with a discussion of the role the frequency-response approach plays among the design techniques available to the worker in the automatic-control field.

Frequency-Response Analysis and Controllability of a Chemical Plant, by A. R. Aikman, Imperial Chemical Industries, Ltd., London, England. 1953 ASME Annual Meeting paper No. 53—A-22 (in type; to be published in Trans. ASME).

THIS paper shows, by describing two examples taken from practical experience of frequency-response methods, the value of these methods in the examination of process-control problems. Numerous papers have advocated the systematic collection and publication of frequency-response data, and it is hoped that the exposition of the two plant investigations in this paper, however fragmentary and incomplete the data may be, will encourage further practical work and interpretation of data taken from actual plants. It can be claimed that the plant data obtained by the frequency-response method are very easy to manipulate, and that the practical technique is now firmly established and applicable without difficulty.

Three procedures are commonly used in the design of process-control systems to give adequate controllability. They are the investigation of the following: (*a*) Alternative routes or paths for the potential correction to follow, in its progress through the plant; or (*b*) the application of individual control loops to every source of disturbance before these can enter the principal control loop; or (*c*) the adjustment of the plant design itself.

It is considered that procedure (*c*) has not been as fully exploited as it deserves.

The developments of improved methods for the calculation of controllability, and the correlation of these calculations with practical results, will in time enable

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Acceptable methods of payment are by check, U. S. postage stamps, **free coupons**[1] supplied to every ASME member, and purchased coupons—ten of which a member may buy for $2 and a nonmember for $4.

When ordering, please give paper number, its title, author's name, and quantity wanted; or use order form.

Orders should be addressed: ASME Order Department, 29 West 39th Street, New York 18, N. Y.

[1] **By the July 23, 1953, action of the Council, all ASME members are to receive ten free coupons annually which they may use to acquire technical papers presented at ASME meetings. The first sets of free coupons were mailed to members in August, 1953.**

NOTE: No digests are made of ASME papers published in full or condensed form in other sections of MECHANICAL ENGINEERING.

ASME publications and advance copies of ASME technical papers are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both at 29 West 39th Street, New York, N. Y.

ASME Transactions and the *Journal of Applied Mechanics* are on file in the main public libraries of large industrial cities and in the technical libraries of engineering colleges having ASME Student Branches.

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53—A-5	53—A-25	53—A-45
53—A-6	53—A-26	53—A-46
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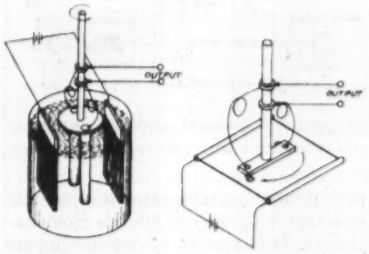
process-control-system designers to predict the performance of these systems with an accuracy much higher than can now be attained. In a more positive sense, the system designer eventually will be able to influence the design of the plant itself so as to take the fullest advantage of the potentialities of automatic control.

Sine-Wave Generators, a Survey of Pneumatic, Mechanical, and Electrical Devices for Obtaining Frequency-Response Data, by D. W. St. Clair, Assoc. Mem. ASME, Eastman Kodak Company, Rochester, N. Y., L. W. Erath, Southwestern Industrial Electronics Company, Houston, Tex., and S. L. Gillespie, Woodward Governor Company, Rockford, Ill. 1953 ASME Annual Meeting paper No. 53—A-12 (in type; to be published in Trans. ASME).

DATA are given on pneumatic, mechanical, and electrical sine-wave generators which are or can be used to impose the "wiggle" necessary for the taking of frequency-response data in the industrial-



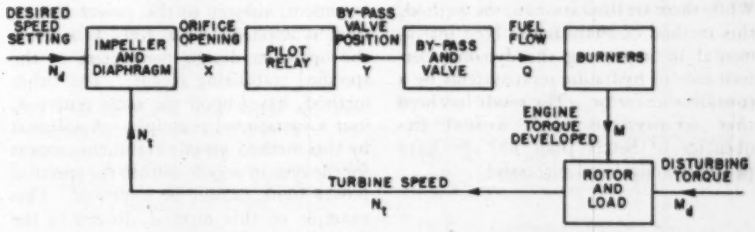
TWO EXAMPLES OF A PRINCIPLE FOR OBTAINING ELECTRICAL SINE WAVES

control field. The high points are covered from a functional rather than a theoretical viewpoint and a reference list is presented to assist those interested in additional information.

Analysis of Regulating Systems With Particular Reference to Speed Control, by R. H. MacMillan, Cambridge University, Cambridge, England. 1953 ASME Annual Meeting paper No. 53—A-15 (in type; to be published in Trans. ASME).

THE design of speed-regulating systems is discussed in relation to that of other closed-loop control systems. Frequency-response methods are found to form a common basis suitable for the analysis of all such systems. The derivation of transfer functions for linear and quasi-linear elements, together with their application to the analysis of regulating systems, is described, and a simplified gas-turbine governor is studied in greater detail.

A summary of the latest work likely to be of importance to control engineers is given, together with extensive references, but it is argued that the best use of the work of others in the field can be made only when a common approach is adopted universally. It is therefore concluded that an elementary study of these methods should be included in the training of every engineering graduate.



SPEED REGULATOR SYSTEM FOR A GAS TURBINE

A Bibliography of the Frequency-Response Method as Applied to Automatic Feedback-Control Systems, by A. M. Fuchs, Bendix Aviation Corp., Teterboro, N. J. 1953 ASME Annual Meeting paper No. 53—A-13 (in type; to be published in Trans. ASME).

THE frequency-response method has grown from its beginning during World War II to its present position as the principal method of analyzing and synthesizing automatic feedback-control systems. This growth can be traced by an examination of the pertinent published material. Dividing this material into fields of interest such as, "Basic Theory," "Nonlinear Systems," "Books," "Applications—Autopilot, Process Control, Components," and so on, makes it possible to study the development of these diverse aspects of the frequency-response method.

This Bibliography has been prepared with the following objectives in mind:

1 To offer a listing of the major contributions to the theory of the frequency-response method and of its application in the analysis, synthesis, and testing of automatic feedback-control systems.

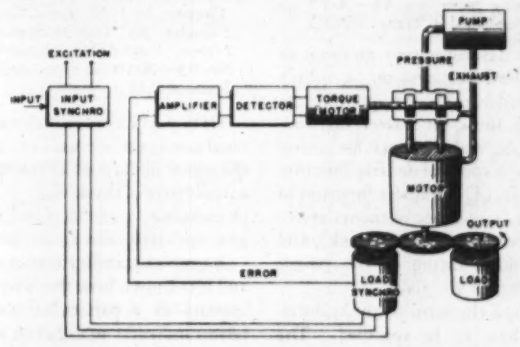
2 To present this material in a manner that will make it more accessible to the engineer who consults it to find the solution for a particular problem.

Application of Frequency-Analysis Techniques to Hydraulic Control Systems, by A. C. Hall, Bendix Aviation Corp., Detroit, Mich. 1953 ASME Annual Meeting paper No. 53—A-16 (in type; to be published in Trans. ASME).

HYDRAULIC control systems, while inherently nonlinear, under many conditions can be studied by means of a linear approximation. Performance may be predicted by this approximation with reasonable accuracy provided the change in fluid flow during a transient is small compared to the steady-state value of the flow.

A valve-motor control system is studied by linear analysis and the frequency-response characteristic obtained. The transfer function of this system is of the third order if the servomotor load is a mass. Expressions for the damping ratio, natural frequency, and sensitivity are obtained.

The method outlined in this paper by means of which the characteristics of the hydraulic system are linearized and its response studied by means of frequency-response techniques has been applied to the development of a number of hydraulic control systems during the past 6 years.



TYPICAL SERVOMECHANISM EMPLOYING HYDRAULIC ELEMENTS

While there are limitations to the method, this method of analysis has been instrumental in improving the dynamic performance of hydraulic servosystems by a considerable factor. The result has been that servosystems with natural frequencies of better than 100 cps have proved practical and successful.

Determination of Transient Response From Frequency Response, by A. Leonhard, Stuttgart Institute of Technology, Stuttgart, Germany. 1953 ASME Annual Meeting paper No. 53—A-14 (in type; to be published in Trans. ASME).

WHEN calculating the transient response of a control loop by means of the classical differential-equation method, the solution of the characteristic equation and the determination of the integration constants become extremely difficult for complicated configurations. If the operational calculus, i.e., the Laplace transformation, is applied, the constants of integration are produced automatically as long as definite but meaningful initial conditions are assumed, and the calculating work is simplified considerably. Even with this method, however, the roots of the characteristic equation must still be found. This presupposes that the equation can be expressed analytically, and that it can be solved, which is not always the case, as for example, if the equation is transcendental. Graphical methods have been developed for such cases, which allow the determination of the transient output response with sufficient approximation and with a moderate amount of calculating work. These methods, based on the frequency response, are treated in detail in this paper, and their practical applications are demonstrated by means of a few problems.

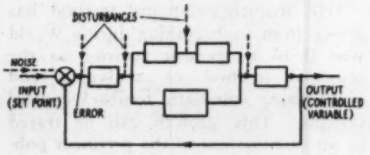
Synthesis of Optimum Feedback Systems Satisfying a Power Limitation, by J. H. Westcott, Imperial College of Science and Technology, London, England. 1953 ASME Annual Meeting paper No. 53—A-17 (in type; to be published in Trans. ASME).

THIS paper describes two methods of synthesizing feedback systems in which stability considerations are qualified by an overriding limit on power demand. The three basic requirements for either method are (*a*) a spectral density function of input signals, (*b*) a transfer function of fixed elements (i.e., basic elements essential for the performance of the task), and (*c*) the maximum rating of the power source. Examples are given.

In one method the form of the stabilizing means has to be specified. The criterion, that the mean square error be a minimum, subject to the power limitation, is applied. This gives as a result the optimum design parameters of the specified stabilizing means. The other method, based upon the same criterion, uses a variational principle. A solution by this method gives a stabilizing means for the system which, within the specified power limit, cannot be improved. One example of this method illustrates the desirability of allowing a finite time delay between the input and the output of a feedback system.

A Uniform Approach to the Optimum Adjustment of Control Loops, by R. C. Oldenbourg, R. Oldenbourg, Inc., and Hans Sartorius, "Regelungstechnik," Munich, Germany. 1953 ASME Annual Meeting paper No. 53—A-18 (in type; to be published in Trans. ASME).

THE common aspects of the problems encountered in achieving optimal adjustment in all fields of automatic control are described. With the aid of a linear and a quadratic measure of error the general principles are obtained by considering the output behavior that follows a normalized



BLOCK DIAGRAM OF GENERALIZED AUTOMATIC-CONTROL SYSTEM

disturbance of the equilibrium. After examining the advantages and disadvantages of these methods as well as the limits of their applicability, a method to be termed "practical optimum" is suggested, which combines general applicability with simplicity of practical handling.

Recent Advances in Nonlinear Servo Theory, by J. M. Loeb, Centre National d'Etudes des Télécommunications, Paris, France. 1953 ASME Annual Meeting paper No. 53—A-19 (in type; to be published in Trans. ASME).

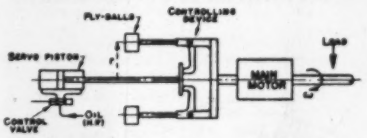
THIS paper concerns the so-called "filtered nonlinear servos," i.e., servos where the signal undergoes a filtering effect from a linear part of the device. "Hereditary" phenomena, such as Coulomb friction, gear backlash, and so on, are dealt with.

A general stability criterion is derived, and it is shown how the Nyquist criterion appears as a particular case. The criterion indicates whether or not a servo is liable to hunt, but it is still necessary to state whether or not the possible hunting will have a limited amplitude.

An approach to this problem is sketched, and it is shown how the first results may be considered as quantitatively valid for quasi-linear systems. Some conclusions previously derived by assuming the transfer functions to be analytic appear as a limiting case of the present results.

A Statistical Approach to Servomechanisms and Regulators, by M. J. Pélegrin, Service Technique Aeronautique, Paris, France. 1953 ASME Annual Meeting paper No. 53—A-20 (in type; to be published in Trans. ASME).

THE servo field is developing rapidly in all of its aspects. The methods presently used are based upon the theory of analytic functions and consist mainly of the study of the system subjected to steady sine-wave disturbances. Recently it has been



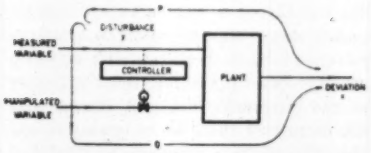
CONTROLLED VARIABLE-INERTIA REGULATOR WITH HYDRAULIC CONTROLLING DEVICE

proved that, in certain cases, it is possible to compute the system directly from statistical data concerning inputs (inputs composed of "orders" and "disturbances").

The paper first reviews the results that were obtained recently by the author in this field. A particular servocircuit is computed by statistical methods, and the output autocorrelation function of a relay also is obtained. Classical and statistical methods are then used in the analysis of a variable-inertia regulator. The principal properties of the variable-inertia regulator are derived for the cases where the inertia is controlled through an external source of power and where the inertia is self-adjusted by a passive network.

Control-System Behavior Expressed as a Deviation Ratio, by J. M. L. Janssen, Royal-Dutch/Shell-Laboratory, Delft, Holland. 1953 ASME Annual Meeting paper No. 53—A-21 (in type; to be published in Trans. ASME).

IN order to bridge the gap between process-control practice and modern control theory, an attempt is made to reduce this theory to its bare essentials. A simple picture is drawn of what control does and how it does it, use being made of the familiar concepts of resonance and damping. Thus a theoretical background is



FUNCTIONAL DIAGRAM OF FEEDFORWARD CONTROL

provided for common-sense judgments on control quality and controller settings. The picture given is applicable to both feedback and feedforward control.

This paper is concerned with a "philosophy" of control, rather than with a "theory." Thus, a qualitative over-all picture of control-system behavior is given, which seems more useful than a quantitative picture of part of its behavior. A distinction is made between what control does and how it does it, the first of which is of interest to chemical engineers concerned with process operations, and both of which are of interest to people concerned with process control. Accordingly, the first two sections, dealing with what control does, are in simple terms, avoiding all mathematics, making use only of the concepts of resonance and damping. In particular, the second section analyzes some aspects of common control practice.

A next section deals with how control works, using only graphical means. The final section is concerned with the theoretical justification of part of the material presented in the earlier sections.

The philosophy presented has its proper field of application in the automatic control of plants in continuous operation.

Frequency-Response Method Applied to the Study of Turbine Regulation in the Swedish Power System, by V. Oja, formerly Swedish Electric Company, ASEA, Sweden, now U. S. subsidiary, Aros Electric, Inc., New York, N. Y. 1953 ASME Annual Meeting paper No. **53—A-23** (in type; to be published in Trans. ASME).

THIS paper describes principles worked out for the design of frequency-power regulation in a power system. The method of analysis is based upon general ideas of frequency-response methods and offers new possibilities for evaluating the regulation properties of power stations. It is aimed to give efficient regulation with the least possible effort. This is attained by matching the feedback data for the governors to the characteristics of the machines and the actual disturbances in the network. This method has been worked out for the Swedish power system. The power system is described briefly, the characteristics of the elements in the regulation loop are given, and the measurements of the frequency-response curve of the power system are reviewed.

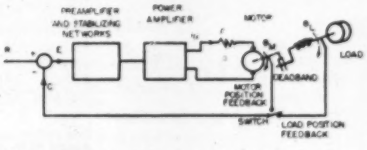
The Use of Zeros and Poles for Frequency Response or Transient Response, by W. R. Evans, North American Aviation, Inc., Downey, Calif. 1953 ASME Annual Meeting paper No. **53—A-24** (in type; to be published in Trans. ASME).

THE concept of zeros and poles of transfer functions permits quick estimates of the frequency response of a system in which the entire picture is based upon vector lengths and angles. The roots of a characteristic equation of the form $1/KG(s) + 1 = 0$ can be sketched readily in the s-plane as a function of K, if the zeros and poles of $G(s)$ are known. The characteristic equation can be obtained in the required form directly, if the roots of the equation are known for two specific values of K with the cases of $K = 0$ and $K = \infty$ frequently being most easily solved. Root-locus plots are a convenient way to keep track of the zeros or poles of a complete system as additional terms or loops are added; the rest of the advantages of zeros or poles are independent of the means by which these points are located.

Approximate Frequency-Response Methods for Representing Saturation and Dead Band, by Harold Chestnut, General Electric Company, Schenectady, N. Y. 1953 ASME Annual Meeting paper No. **53—A-25** (in type; to be published in Trans. ASME).

THIS paper indicates there are numerous nonlinear elements having saturation or dead-band characteristics for which an "equivalent linear coefficient" may be used as the describing function. The equivalent gain factors for saturation and dead band are shown to have a somewhat complementary nature and to be of relatively simple form.

Although the results of using this approximate method of analyzing backlash and saturation do not provide an exact solution, they do permit the designer to obtain useful qualitative results. As such, this method is particularly helpful for use in the more complex systems such as are generally encountered in practice, but that do not lend themselves to more exact analytical treatment.



POSITION CONTROL HAVING MECHANICAL DEAD BAND AND SPRING-MASS, VISCOUS-DAMPING LOAD

Stability Characteristics of Closed-Loop Systems With Dead Band, by C. H. Thomas, General Electric Company, Schenectady, N. Y. 1953 ASME Annual Meeting paper No. **53—A-26** (in type; to be published in Trans. ASME).

THE frequency-response method of analysis greatly facilitates the study of the effect of dead band in closed-loop systems. The results obtained in this paper, although approximate, are in a form which enables the designer to determine means of suppressing or preventing the small-amplitude oscillations which occur.

The frequency-response method of analysis is well suited for the study of automatic-control systems where some nonlinearity may produce sustained oscillations. The approximations generally made in such analyses are justified on the basis that automatic-control systems are essentially low-pass filters, resulting in an input signal to the nonlinear element nearly sinusoidal in form. The analysis presented, however, shows that this is not necessarily a limitation, although this fact does simplify the analytical procedure. As long as the signals are of the periodic type, and the form of the input wave to the nonlinear element is known, the fundamental frequency-transfer ratio usually can be determined. The complexity of analysis is reduced by approximating the input wave by a simple Laplace transformable function.

In cases where the input wave to the nonlinear element, as in the case of dead band, does not change its form appreciably with frequency, the fundamental frequency-transfer ratio is truly amplitude-variant. If, however, the input wave changes form with frequency in such a way that phase shift of the fundamental frequency is produced, then the fundamental frequency-transfer ratio may become frequency-variant as well as amplitude-variant. The degree to which this occurs will depend upon the frequency-response characteristics of the entire closed-loop system. Fortunately, this effect is usually small.

Heat Transfer

The Tabulation of Imperfect-Gas Properties for Air, Nitrogen, and Oxygen, by Newman A. Hall, Mem. ASME, and Warren E. Iberle, Assoc. Mem. ASME, University of Minnesota, Minneapolis, Minn. 1953 ASME Annual Meeting paper No. **53—A-5** (in type; to be published in Trans. ASME).

RECENT theoretical developments of

intermolecular forces have established a basis upon which a valid extension of gas-property data may be prepared. This paper establishes the fact that deviation from perfect-gas behavior may be expressed fundamentally by the compressibility factor. Tables of virial coefficients and temperature derivatives for air, nitrogen, and oxygen are given, as well as tables of compressibility factors for these three gases.

Thermal Conductivity of Some Industrial Liquids From 0 to 100 C, by H. L. Mason, Mem. ASME, Office of Basic Instrumentation, National Bureau of Standards, Washington, D. C. 1953 ASME Annual Meeting paper No. **53—A-40** (in type; to be published in Trans. ASME).

BECAUSE of discrepancies among published values for thermal conductivity of liquids, the Iowa Engineering Experiment Station undertook a series of thermal-conductivity measurements on a number of nonmetallic, noncorrosive, lower-viscosity liquids, with the results reported in this paper.

Thermal Conductivity of Gases, by F. G. Keyes, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1953 ASME Annual Meeting paper No. **53—A-58** (in type; to be published in Trans. ASME).

THIS paper is a continuation of earlier reported work in connection with two of the fundamental properties required for understanding and designing heat-transfer equipment. New measurements of heat conductivity are presented along with values for viscosity obtained by correlation of all available data found in the literature. The simplest substance from the point of view of theory is the monatomic gas. The results of a study of the five rare gases are included.

Measurement of the Viscosity of Five Gases at Elevated Pressures by the Oscillating-Disk Method, by J. Kestin, Brown University, Providence, R. I., and K. Pilarczyk, Worthington Corp., Harrison, N. J. 1953 ASME Annual Meeting paper No. **53—A-67** (in type; to be published in Trans. ASME).

THIS paper describes the measurement of the influence of pressure on the viscosity of five commercially pure gases: Air, nitrogen, hydrogen, argon, and helium, in a range up to about 70 atm (1000 psi) at room temperature (20 or 21 C). The viscosity was measured by observing the period of oscillation and the logarithmic decrement of an optically ground-quartz disk of 70 mm diam suspended on a thin rhodium-platinum wire between two fixed optically ground-quartz plates with a separation of 1 mm, and performing torsional oscillations. The data were evaluated on the basis of Macwood's equations, but the instrument proved capable of a higher accuracy of measurement than the 1 per cent inherent in the theory. The scatter of experimental data did not exceed 0.1 per cent and repeatability was of the same order of accuracy. In view of the mathematical difficulties no attempt was made to improve the theory of the instrument but it is shown that the motion of the disk is nonlinear and that the relation between the period of oscillation and the logarithmic decrement is not that which would be expected on the assumption of simple damped harmonic motion.

Steam Power Generation

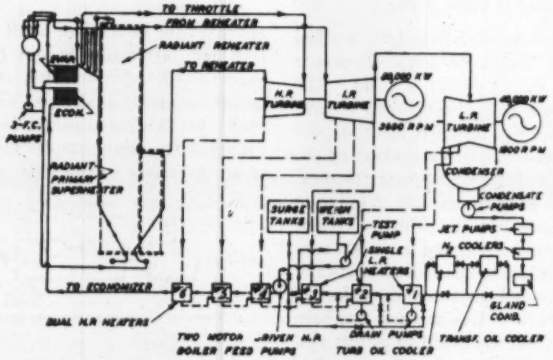
Testing Large Steam Turbines With Weighing Tanks, by W. A. Pollock, Mem. ASME, Wisconsin Electric Power Company, Milwaukee, Wis. 1953 ASME Annual Meeting paper No. **53—A-66** (in type; to be published in Trans. ASME).

FORTY THREE years of favorable experience with weighed-water testing of steam turbines influenced a decision to install scale tanks at Wisconsin Electric Power Company's new Oak Creek Power Plant to permit testing the 120,000-kw cross-compound reheat turbines. At a total cost of less than ten cents per kilowatt installed capacity, the weighing tanks serve the dual purpose of providing a means for testing turbines and their auxiliaries accurately and a needed facility for storage of cold condensate. Manufacturers' guarantees of turbine heat rates can be checked more reliably and closely than with flowmeters, and with assurance of accurate reliable tests the manufacturer frequently can improve his guarantee.

Once favorable guarantee commitments are made, experience shows that the manufacturer makes special efforts to provide the very best design. He also encourages operation at closer clearances to attain the better heat rates. Other advantages are the help in evaluating turbine internal condition, which may or may not require overhaul, and in learning the effects of changes in clearance adjustments and in design changes. Routine tests are conducted with a minimum of preparation time and a relatively small test crew. Accurate measurement of all values of steam flow, electrical output, pressure, and temperature are required for reliable results, but the major emphasis on accuracy is placed on the input and output quantities which have the greatest effect on the result. The paper concludes that weighing tanks can well be considered a definite requirement whenever it is possible to fit them into the flow cycle.

Elastic Constants and Coefficients of Thermal Expansion of Piping Materials Proposed for 1954 Code for Pressure Piping, by Rudolph Michel, Mem. ASME, Bureau of Ships, Navy Department, Washington, D. C. 1953 ASME Annual Meeting paper No. **53—A-52** (in type; to be published in Trans. ASME).

IN June, 1951, the Committee on Piping Flexibility of the American Standards Association, designated as ASA Committee B-31, met in order to consider a revision of the Code for Pressure Piping. The work of Committee B-31 was carried on by three subgroups of which Subgroup No. 2 was given the task of pre-

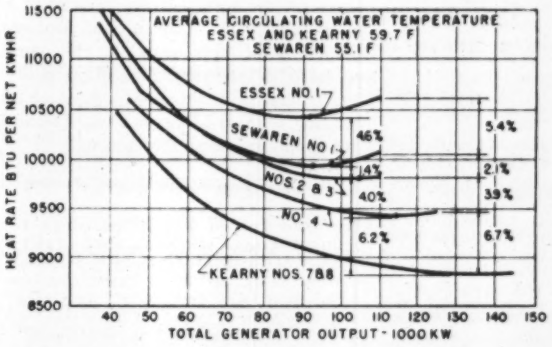


FLOW DIAGRAM—120,000-KW INSTALLATION—OAK CREEK POWER PLANT, SHOWING WEIGHING TANKS IN PLACE

paring data on elastic constants and coefficients of thermal expansion of piping materials. Since the new edition of the Code for Pressure Piping will contain only tabulated values of the subject matter, it was felt by ranking members of the B-31 Committee that a more detailed explanation of the sources of data and their probable accuracy would be helpful to users of the Code. The tabulated data presented in this paper are proposed for inclusion in the 1954 edition of the Code for Pressure Piping and are published for the purpose of inviting criticism and comment.

The New Kearny Generating Station, by F. P. Fairchild, Fellow ASME, Public Service Electric and Gas Company, Newark, N. J. 1953 ASME Annual Meeting paper No. **53—A-71** (in type; to be published in Trans. ASME).

THIS paper describes the more important features of the design of the new Kearny Generating Station and points out the significant differences between Kearny and Sewaren. Outstanding features are



CALCULATED PLANT HEAT RATES

the steam conditions, 2350 psig, 1100 F-1050 F; pressurized firing of boilers; controlled circulation in boilers; gas recirculation; side-exhaust turbines with twin condensers and no expansion joint between turbine and condenser; an experimental high-speed boiler feed pump; and a completely austenitic main steam system.

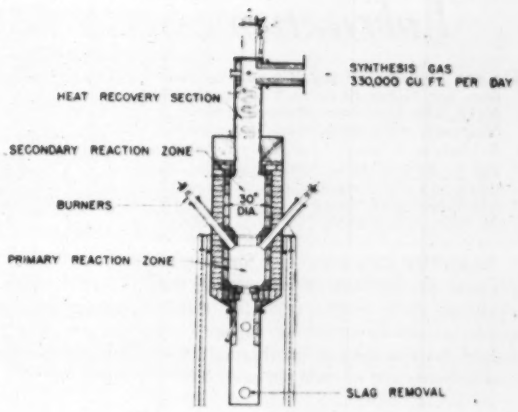
While this project is the first capacity addition at the Kearny site in more than 20 years, it is actually another step in the technical progress which, after World War II, appears successively in the new capacity additions to the electric system of Public Service Electric and Gas Company. The new Kearny Generating Station is then the next step after Sewaren. The plant heat-rate curves for these installations show that substantial technical progress has occurred in this period. The Kearny units have a calculated net heat rate, based on equipment guarantees, of 8830 Btu per kwhr, as compared to 10,400 Btu per kwhr for No. 1 Unit at Essex. This is an improvement of more than 15 per cent in a little more than five years.

There is a striking contrast between the original Kearny, which commenced operation in 1925, and the new installation. Early in the design work it was realized that the compromises necessary to integrate the new structure with the old could not be justified, and it was then decided to design the new plant, as far as practicable, as a new generating station, disregarding the somewhat natural tendency to harmonize the two. This is manifest in the semioutdoor construction, the lower elevation of the operating floor, and many other features.

Fuels

Pulverized-Coal-Fired Gasifier for Production of Carbon Monoxide and Hydrogen, by P. R. Grossman, Assoc. Mem. ASME, and R. W. Curtis, The Babcock & Wilcox Company, Alliance, Ohio. 1953 ASME Annual Meeting paper No. **53—A-49** (in type; to be published in Trans. ASME).

THIS paper describes a pilot-plant pulverized-coal gasifier installed at the



PULVERIZED-COAL GASIFIER PILOT PLANT AT U. S. BUREAU OF MINES, MORGANTOWN, W. VA

Morgantown Station of the Bureau of Mines and a semicommercial gasifier of similar design installed at the E. I. du Pont de Nemours Company, Inc., Belle, W. Va.

A brief summary of the operating data obtained from these two units is presented and material requirements are given for this method of coal gasification.

A large-size unit of this design is now under construction and will go into operation next year. This will be the first commercial application of the process in this country. Details of the design that provide for handling of coal ash of widely varying fusing temperatures are given in an effort to point out those features which have contributed to continuous uninterrupted operation. Included also is a discussion of heat flow within the gasification unit to illustrate the factors involved in obtaining an economical process.

Hydraulic Power

Vibration of the Grand Coulee Pump-Discharge Lines, by John Parmakian, Mem. ASME, Bureau of Reclamation, U. S. Department of the Interior, Denver, Colo. 1953 ASME Annual Meeting paper No. **53—A-50** (in type; to be published in Trans. ASME).

THIS paper describes a program of field tests, analyses, and modifications at the Grand Coulee Pumping Plant which were made to reduce the periodic vibration of the exposed sections of the pump-discharge lines. The source of the discharge-line vibration was traced to pressure oscillations originating in the pump.

The vibration of the discharge lines subsequently was reduced to acceptable limits by a series of modifications of the pumps and discharge lines.

Lubrication

On the Solution of the Reynolds Equation for Slider-Bearing Lubrication—VIII, The Optimum Slider Profile for Viscosity, a Function of the Pressure, by A. Charnes, F. Osterle, Assoc. Mem. ASME, and E. Saibel, Mem. ASME, Carnegie Institute of Technology, Pittsburgh, Pa. 1953 ASME Annual Meeting paper No. 53—A-38 (in type; to be published in Trans. ASME).

TREATING viscosity as a function of pressure, the problem of determining the optimum slider profile from the standpoint of load-supporting capacity is solved for the case of isothermal flow and is discovered to yield the same profile as Rayleigh found assuming constant viscosity. It is shown how the increase in load-supporting capacity resulting from viscosity variation may be calculated.

Observations on Some Factors Affecting Timken Data for EP Lubricants, by A. J. DeArdo and E. M. Kipp, Aluminum Research Laboratories, Aluminum Company of America, New Kensington, Pa. 1953 ASME Annual Meeting paper No. 53—A-39 (in type; to be published in Trans. ASME).

THIS paper reports results of an investigation of variations in rubbing speed and viscosity variables when using the Timken machine for evaluation of EP lubricants.

Applied Mechanics

Reflection of Flexural Waves at the Edge of a Plate, by T. R. Kane, University of Pennsylvania, Philadelphia, Pa. 1953 ASME Annual Meeting paper No. 53—A-42 (in type; to be published in the *Journal of Applied Mechanics*).

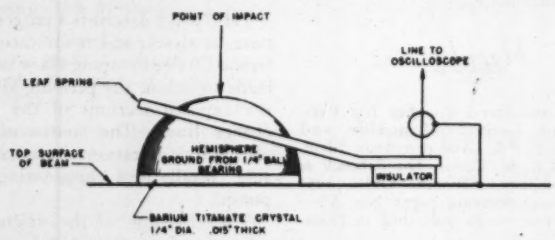
THE reflection of straight-crested flexural waves at the edge of a semi-infinite plate is studied in terms of a two-dimensional plate theory. It is found that, in general, a flexural wave propagated toward the edge at an arbitrary angle of incidence gives rise to three reflected waves, two flexural waves, and a shear wave. A number of special cases, involving degenerate forms of these motions, are investigated in detail.

Forced Motions of Elastic Rods, by G. Herrmann, Columbia University, New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-59 (in type; to be published in the *Journal of Applied Mechanics*.)

IN a recent paper by Mindlin and Herrmann, a one-dimensional theory of compressional waves in an elastic rod was described. This theory takes into account both radial inertia and radial shear stress and, accordingly, contains two dependent variables instead of the one axial displacement of classical rod theory. The solution of the equations for the case of forced motions thus involves complications not usually encountered. The difficulties may be surmounted in several ways, one of which is presented in this paper. The method described makes use of Lagrange's equation of motion and reduces the most general problem of forced motion to a free-vibration problem and a quadrature.

Propagation of Elastic Impact in Beams in Bending, by M. A. Dengler, Martin Goland, Mem. ASME, and P. D. Wickersham, Midwest Research Institute, Kansas City, Mo. 1953 ASME Annual Meeting paper No. 53—A-46 (in type; to be published in the *Journal of Applied Mechanics*).

A THEORETICAL and experimental comparison is made of the strain propagation in steel beams impacted by a sharp, transverse blow. The theoretical analysis is based on an earlier paper by Dengler and Goland, in which a solution based on the Timoshenko bending mechanism is deduced. The experimental work was performed on a square beam, impacted by a steel sphere. Measurements are reported both for the strain propagation in the beam and also for the history of forces acting between the ball and beam.



DIAGRAMMATIC SKETCH OF FORCE GAGE DESIGNED TO MEASURE FORCES APPLIED TO BEAM

The results of the comparison show excellent agreement between the observed and predicted strain propagation, so long as the beam behaves essentially in bending. It is pointed out in the discussion, however, that many impacted beams do not perform essentially in bending, so that the present work does not apply. A small-amplitude high-frequency strain component, not properly predicted by the theory, is also encountered in the experimental data.

A Theory of Torsion Bending for Multicell Beams, by S. U. Benscoter, California Institute of Technology, Pasadena, Calif. 1953 ASME Annual Meeting paper No. 53—A-27 (in type; to be published in the *Journal of Applied Mechanics*).

DIFFERENTIAL equations and boundary conditions, relating warping displacements and rotations to the applied torsional load, are developed for nonuniform beams with thin-walled multicell cross sections. The loading distribution and end conditions are arbitrary. A formula resembling the flexure formula is given for the normal stress in terms of a warping moment. The torsion bending theory is of approximately the same accuracy as engineering bending theory and is exactly analogous to the case of bending with axial tension when shearing strains are taken into account.

Free and Forced Vibrations of an Infinitely Long Cylindrical Shell in an Infinite Acoustic Medium, by H. H. Bleich, Mem. ASME, and M. L. Baron, Columbia University, New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-37 (in type; to be published in the *Journal of Applied Mechanics*).

THE paper presents a general method for the treatment of free and forced-vibration problems of infinitely long thin cylindrical shells. Surprisingly simple results are obtained by utilizing the known and tabulated modes of the shell in vacuo as generalized co-ordinates describing the response of the shell, according to the paper. The frequencies of free vibrations of submerged shells are obtained, and the response of the shell and medium to sinusoidally distributed, periodic, radial forces is determined.

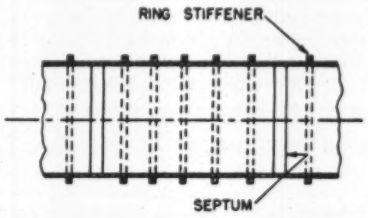
The results indicate that there is a low-frequency range where no radiation occurs and a high-frequency range where energy is radiated. Free vibration, or resonance in the case of forced vibrations, occurs only in the low-frequency range. The results of the paper may be applied to obtain the response to arbitrarily distributed, periodic, or nonperiodic forces

by expanding such forces in Fourier series and/or integrals.

The results for free and forced vibrations are discussed in general, and for the specific case of steel shells in water. Tables are provided to facilitate numerical computations. With limitations, the method is also applicable to ring-stiffened shells, and to the case of a static pressure in the surrounding medium.

Dynamic Behavior of Reinforced Cylindrical Shells in a Vacuum and in a Fluid, by Miguel C. Junger, Assoc. Mem. ASME, Harvard University, Cambridge, Mass. 1953 ASME Annual Meeting paper No. **53—A-1** (in type; to be published in the *Journal of Applied Mechanics*).

THE vibrations of an infinite cylindrical shell reinforced with periodically spaced septa and stiffening rings are studied in a vacuum and in a fluid medium. Lagrange equations are used to derive the dynamic equations; the fluid reaction is obtained from the solution of the wave equation. The solution gives the dynamic characteristics of the shell, the amplitude of



SHELL REINFORCED WITH SEPTA AND STIFFENING RINGS

forced vibration, and the sound field generated thereby. The theory can be extended to shells embodying complex stiffening structures and load distributions. Certain features of the fluid reaction suggest interesting applications: Its inertial component becomes extremely large under certain conditions, thus tending to eliminate some modes of vibration; also, the resistive, i.e., damping, component may vanish for certain modes, which therefore do not radiate any sound.

On the Equations of Motion of Cylindrical Shells, by P. M. Naghdi, Assoc. Mem. ASME, and J. G. Berry, Assoc. Mem. ASME, University of Michigan, Ann Arbor, Mich. 1953 ASME Annual Meeting paper No. **53—A-34** (in type; to be published in the *Journal of Applied Mechanics*).

FROM the basic equations of thin cylindrical shells consistent with Love's first approximation, three uncoupled displacement equations of motion are deduced, the effect of rotary inertia being neglected. Comparison is made with the works of other authors who have used a variety of approximations in arriving at the equations of motion of cylindrical shells. Thus, in a qualitative manner, further insight is gained as to the effectiveness and practicality of these approximations in the solutions of problems of cylindrical shells.

Tables for Frequencies and Modes of Free Vibration of Infinitely Long Thin Cylindrical Shells, by M. L. Baron and H. H. Bleich, Mem. ASME, Columbia University, New York, N. Y. 1953 ASME Annual Meeting paper No. **53—A-33** (in type; to be published in the *Journal of Applied Mechanics*).

TABLES are presented for the quick determination of the frequencies and shapes of modes of infinitely long thin cylindrical shells. To make the problem tractable, the shells are first treated as membranes without bending stiffness, and the bending effects are introduced subsequently as corrections. The underlying theory is based on the energy expressions for cylindrical shells. The tables cover the following range: Lengths of longitudinal half wave L from 1 to 10 radii a; number n of circumferential waves from 0 to 6. The results apply for Poisson's ratio $\nu = 0.30$.

Stresses in a Metal Tube Under Both High Radial-Temperature Variation and Internal Pressure, by Chieh-Chien Chang and Wen-Hua Chu, The Johns Hopkins University, Baltimore, Md. 1953 ASME Annual Meeting paper No. **53—A-4** (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper treats the stress distribution in a metal tube which is subject to a very high radial-temperature variation and pressure. The radial-temperature distribution across the tube wall and the variations of the modulus of elasticity and the coefficient of thermal expansion are obtained from experimental data, and all these effects of temperature are taken into account in the calculations. The fundamental equations in the case of plane strain and plane stress can be formulated as the nonhomogeneous Whittaker differential equations. The corresponding solutions are obtained by the method of variation of parameters and in terms of Kummer series. An example is shown, and the stress distribution across the wall is given. For comparison, the stress distribution of the case of constant modulus of elasticity and coefficient of expansion is included.

On the Strain Energy of Shells, by H. L. Langhaar, Mem. ASME, University of Illinois, Urbana, Ill., and D. R. Carver, Kansas State College, Manhattan, Kan. 1953 ASME Annual Meeting paper No. **53—A-10** (in type; to be published in the *Journal of Applied Mechanics*).

IN a previous paper the strain energy of a shell was derived with the aid of the assumption that only the linear terms in the thickness co-ordinate z need be retained in the expressions for the strains. Recently, Bleich and DiMaggio derived a strain-energy expression for circular cylindrical shells without using power series in z. The present paper shows that power series in z may be eliminated, in general, and that the errors caused by linearizing approximations are frequently significant.

Stress Concentrations Around a Small Spherical or Spheroidal Inclusion on the Axis of a Circular Cylinder in Torsion, by Sisir Chandra Das, Chandernagore College, West Bengal, India. 1953 ASME Annual Meeting paper No. **53—A-2** (in type; to be published in the *Journal of Applied Mechanics*).

STRESSES are calculated for the case of a small elastic inclusion bonded (i.e., continuous displacements and tractions across the surface of the inclusion) to a large circular cylindrical shaft. The inclusions considered are of spherical and spheroidal shapes. The results are discussed for several particular cases.

Stresses and Deformations of Flanged Shells, by G. Horvay, Mem. ASME, and I. M. Clausen, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1953 ASME Annual Meeting paper No. **53—A-43** (in type; to be published in the *Journal of Applied Mechanics*).

SIMPLE formulas are given for the effect of a flange on the deformations and stresses of an attached shell.

Determination of the reinforcement provided by a flange is a basic and recurrent design problem. While this subject has been discussed extensively in the literature and also in various codes, there does not seem to be available a simple, quick, yet reliable procedure for solution of the problem when the shell is noncylindrical. The scheme of calculation, developed in this paper, aims at filling this gap. The analysis involves the following steps:

1 Consider the shell and flange severed at their juncture and determine the misalignments of (and the stresses in) the two members under the direct loads or the temperature variations they experience (membrane analysis).

2 Calculate the internal reactions necessary to re-establish continuity of shell and flange.

3 Determine the stresses and displacements induced by these internal reactions (edge-load analysis).

4 Superpose the stresses and displacements so obtained on those determined in 1.

Analysis of Plastic Deformation in a Steel Cylinder Striking a Rigid Target, by E. H. Lee, Mem. ASME, Brown University, Providence, R. I., and S. J. Tupper, Fort Halstead, Kent, England. 1953 ASME Annual Meeting paper No. 53—A-28 (in type; to be published in the *Journal of Applied Mechanics*).

THE G. I. Taylor dynamic compression test consists of firing a cylinder of the material to be tested at a target of hardened armor plate, and deducing the dynamic yield stress from the resulting deformation. In the interpretation of the results, interest is concentrated on the wave front of initial plastic straining. This paper attempts the theoretical determination of the entire strain distribution in such a test cylinder of nickel-chrome steel. This material was chosen because the dynamic influence on the stress-strain relation is likely to be small, thus permitting the static relation to be used in the theory. Strain distributions deduced by two theoretical approaches compare satisfactorily with the distribution of strain obtained in such a dynamic compression test, thus justifying the assumption for this material at the speed considered. The treatment of this problem requires a theory of the propagation of plastic waves, which is developed in this paper, for the particular type of stress-strain curve pertaining to the high-strength alloy steel tested.

Coulomb Friction, Plasticity, and Limit Loads, by D. C. Drucker, Mem. ASME, Brown University, Providence, R. I. 1953 ASME Annual Meeting paper No. 53—A-57 (in type; to be published in the *Journal of Applied Mechanics*).

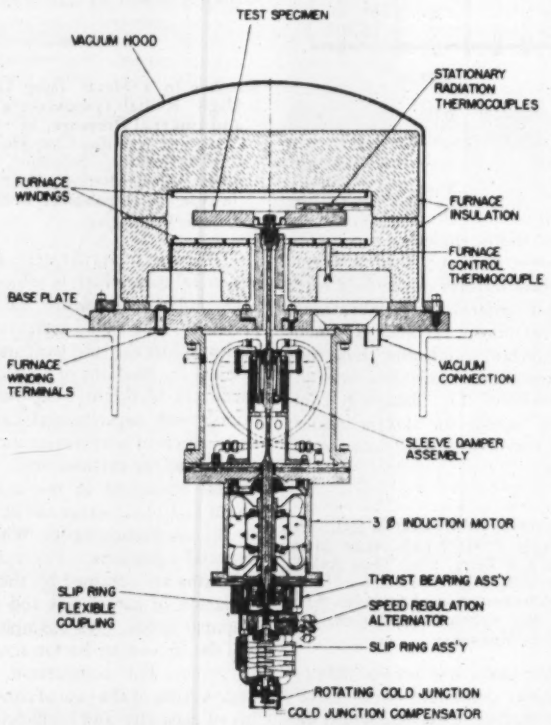
ADDITIONAL attention is given to the somewhat subtle but extremely important difference between Coulomb friction and the apparently corresponding resistance to plastic deformation, in this paper. It is shown that the limit theorems previously proved for assemblages of perfectly plastic bodies do not always apply when there is finite sliding friction. Theorems are developed which relate the limit loads with finite Coulomb friction to the extreme cases of zero friction and complete attachment, and also to the case where the frictional interfaces are "cemented" together with a cohesionless soil.

The Plasticity of an Isotropic Aggregate of Anisotropic Face-Centered Cubic Crystals, by A. V. Hershey, U. S. Naval Proving Ground, Dahlgren, Va. 1953 ASME Annual Meeting paper No. 53—A-63 (in type; to be published in the *Journal of Applied Mechanics*).

THE plasticity of a polycrystalline aggregate is expressed in terms of the plasticity of the individual grains. It is assumed that the local deviation of stress from the average stress is proportional to the local deviation of strain from the average strain, and it is assumed that plastic flow begins when there is an average of three active slip systems per grain. The plastic states of a grain are mapped as a function of the orientation of the crystallographic axes. A coexistence of different states of strain with different rotations of the axes at the same state of stress can be correlated with the occurrence of deformation bands. A range of orientations is illustrated in which the axes tend to congregate quickly and then move more slowly toward a stable end orientation. The residual strain which would be observed by x-ray diffraction after the release of stress is calculated for three sets of diffracting planes. The applications of the theory have so far been limited to face-centered cubic polycrystals with intrinsic elastic isotropy.

Creep Tests of Rotating Disks at Elevated Temperature and Comparison With Theory, by A. M. Wahl, Fellow ASME, G. O. Sankey, Assoc. Mem. ASME, M. J. Manjoine, Mem. ASME, and E. Shoemaker, Westinghouse Research Laboratories, East Pittsburgh, Pa. 1953 ASME Annual Meeting paper No. 53—A-61 (in type; to be published in the *Journal of Applied Mechanics*).

A THEORETICAL and experimental program involving methods of calculating creep in rotating disks at elevated temperatures is described. This program consisted primarily of the following: (*a*) Obtaining forged disks from the same ingot of 12 per cent chrome steel, all disks being forged and heat-treated in the same manner; (*b*) making spin tests at 1000 F on three of these disks for periods up to about 1000 hr; (*c*) making long-time tension-creep tests at 1000 F on many specimens cut out circumferentially from several of the other disks at stresses approximating those of the spin tests; (*d*) investigating theoretical methods of calculation of creep deformation in such disks; and (*e*) comparison of spin-test results with those calculated theoretically using average tension-creep data.



CROSS SECTION OF HIGH-SPEED DISK TESTER

It was found that available methods of calculating rotating disks based on the Mises criterion gave creep deformations too low compared to the test values, i.e., on the unsafe side for design. Considerably better agreement between test and theoretical results is obtained if the latter is based on the maximum-shear theory. Some discussion is given of the reasons for the better agreement obtained using the latter theory. These are believed to be related to the anisotropy of the forged material tested. Further tests on other materials are necessary before general conclusions can be drawn. However, in the absence of test data it is suggested that a conservative course in design for such disks is to apply the maximum-shear theory.

The Elasticity of an Isotropic Aggregate of Anisotropic Cubic Crystals, by A. V. Hershey, U. S. Naval Proving Ground, Dahlgren, Va. 1953 ASME Annual Meeting paper No. 53—A-62 (in type; to be published in the *Journal of Applied Mechanics*).

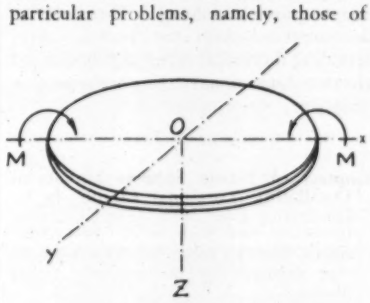
THE elasticity of a polycrystalline aggregate is expressed in terms of the elasticity of the individual grains. The stress within each grain is estimated with the aid of an analysis of the stress distribution around a spherical cavity in an isotropic medium. The strain within each grain is expressed in terms of the average stress in the polycrystal as a whole by pseudoelastic constants which are related to the actual elastic constants. The calculated elasticities for physical tests and for x-ray diffraction measurements in polycrystals are given for a few cubic metals.

Plastic Flow in a Rectangularly Notched Bar Subjected to Tension, by E. H. Lee, Mem. ASME, Brown University, Providence, R. I. 1953 ASME Annual Meeting paper No. 53—A-29 (in type; to be published in the *Journal of Applied Mechanics*).

A TWO-DIMENSIONAL notched bar with rectangular root pulled in tension is considered. Large strains are analyzed so that plastic-rigid theory can be used. The initial motion based on the undeformed boundaries is considered and also the subsequent flow including the deformation of the notch boundaries. In the absence of fracture, the solution can be continued until only line contact occurs at the notch root. The solution satisfies stress and velocity conditions for a St. Venant-Mises material in plastic flow at each stage of the deformation. The unsteady, large strain motion can be analyzed, including the determination of the unknown free surface and the plastic-rigid boundary, due to a special property of the velocity solution and to the statical determinacy of the stress field in terms of the free-surface geometry.

Bending of Isotropic Thin Plates by Concentrated Edge Couples and Forces, by Yi-Yuan Yu, Assoc. Mem. ASME, Washington University, St. Louis, Mo. 1953 ASME Annual Meeting paper No. 53—A-32 (in type; to be published in the *Journal of Applied Mechanics*).

IN this paper the complex variable method of Muschelišvili for solving the biharmonic equation is applied to problems of bending of isotropic thin plates by concentrated edge couples and forces. The results of the method as applied to plate problems by previous authors are presented first. Methods of handling concentrated edge couples and forces are developed. These are then applied to the circular plate as an example, for which exact solutions in closed forms are obtained. Worked out in detail are three particular problems, namely, those of



CIRCULAR PLATE SUBJECTED TO TWO BENDING COUPLES

circular plates subjected, respectively, to two bending couples, to two twisting couples, both applied at the ends of a diameter, and to four forces applied at the ends of two diameters perpendicular to each other. Numerical results are presented in the form of graphs.

Bending of Circular and Ring-Shaped Plates on an Elastic Foundation, by Herbert Reismann, Consolidated Vultee Aircraft Corp. and Southern Methodist University, Fort Worth, Texas. 1953 ASME Annual Meeting paper No. 53—A-7 (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper develops a method for the evaluation of deflections, moments, shears, and stresses of a circular or ring-shaped plate on an elastic foundation under transverse loads. A series solution is derived for plates subjected to edge and/or concentrated loads and is given in terms of tabulated functions. It is exact within the assumptions underlying the classical theory of plates and includes, as a particular case, the known solution of the corresponding radially symmetric problem.

Two examples displaying radial asymmetry are worked. A solution is given for (*a*) a circular plate resting on an elastic foundation, clamped at the boundary and subjected to an arbitrarily placed concentrated load, and (*b*) a plate of infinite extent, resting on an elastic foundation and clamped to the boundary of a rigid circular disk to which a pure moment is applied.

Stress Concentration Due to Elliptical Holes in Orthotropic Plates, by H. D. Conway, Assoc. Mem. ASME, Cornell University, Ithaca, N. Y. 1953 ASME Annual Meeting paper No. 53—A-30 (in type; to be published in the *Journal of Applied Mechanics*).

TWO plane stress problems of elliptical holes in infinite orthotropic sheets are treated: (*a*) Hole loaded by a pair of concentrated forces acting at the ends of the major or minor axis, and (*b*) hole in plate which is subjected to uniform tension. The solutions are obtained in a simple manner by transformation from corresponding problems in which the holes are circular. Closed-form expressions are obtained for the stress-concentration factors.

A Numerical Solution for the Nonlinear Deflection of Membranes, by F. S. Shaw and N. Perrone, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. 1953 ASME Annual Meeting paper No. 53—A-36 (in type; to be published in the *Journal of Applied Mechanics*).

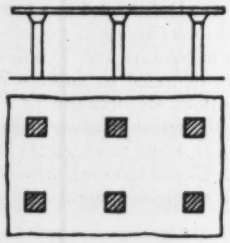
A NUMERICAL method of solution for the nonlinear deflection of thin flat membranes subjected to normal forces as well as forces in the plane of the membrane has been given by Hencky. The equations he solved were first derived by Föppl, and they also follow directly from the von Kármán nonlinear-plate equations formally making the plate stiffness zero. Föppl's equations are two in number, one being of fourth order and the other, second. The unknown quantities are a stress function and the normal displacement. Hencky's method of solution does not seem capable of easy generalization. The same class of membrane problems is reconsidered in this paper.

By casting the problem entirely in terms of displacement components three simultaneous nonlinear second-order partial differential equations are obtained, and a technique is devised by means of which these equations can be solved

without difficulty using finite-difference approximations in conjunction with a relaxation-iteration procedure. Various simple preliminary examples are discussed, after which an example involving a rectangular region is considered in complete detail. The technique devised can be used for a region of any shape, including the case where the boundary is curved, and also for any arbitrary given load system.

On Bending of a Flat Slab Supported by Square-Shaped Columns and Clamped, by S. Woinowsky-Krieger, Laval University, Quebec City, Can. 1953 ASME Annual Meeting paper No. 53—A-60 (in type; to be published in the *Journal of Applied Mechanics*).

A SOLUTION is given in this paper for the problem of bending of an infinite flat slab loaded uniformly and rigidly clamped in square-shaped columns arranged to form the square panels of the slab. The complex variable method in connection



SECTION OF A FLAT SLAB, GROUND PLAN AND ELEVATION

with conformal mapping is used for this aim. Although not perfectly rigorous, the solution obtained is sufficiently accurate for practical purposes and, besides, it can be improved at will. Stress diagrams traced in a particular case of column dimensions do not wholly confirm the stress distribution, generally accepted in design of flat slabs.

The Stresses in a Flat Curved Bar Resulting From Concentrated Tangential Boundary Loads, by Ning-Gau Wu, Jacuzzi Brothers, Inc., Richmond, Calif., and C. W. Nelson, Mem. ASME, University of California, Berkeley, Calif. 1953 ASME Annual Meeting paper No. 53—A-47 (in type; to be published in the *Journal of Applied Mechanics*).

THE Fourier integral method is applied to plane-stress problems of a curved bar bounded by two concentric circles and loaded by concentrated tangential boundary loads. The solutions presented may be combined with results given in previous papers dealing with radial boundary loads so as to obtain the stresses in a curved bar loaded by any combination of concentrated boundary loads inclined at any angle to the radial direction.

Stress Concentration Due to a Hemispherical Pit at a Free Surface, by R. A. Eubanks, Illinois Institute of Technology, Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-8 (in type; to be published in the *Journal of Applied Mechanics*).

THIS paper contains a solution in series form for the stresses and displacements around a hemispherical pit at a free surface of an elastic body. The problem is idealized by considering a semi-infinite medium which otherwise is bounded by a plane. At infinity the body is assumed to be in a state of plane hydrostatic tension perpendicular to the axis of symmetry of the pit. The present method of solution may be generalized to loadings which are not rotationally symmetric. Numerical results are given for the variation along the axis of symmetry of the normal stress which is parallel to the tractions at infinity. These results are compared with the known corresponding numerical values appropriate to the two-dimensional analog of the present problem.

Contact of Elastic Spheres Under an Oscillating Torsional Couple, by H. Deresiewicz, Assoc. Mem. ASME, Columbia University, New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-31 (in type; to be published in the *Journal of Applied Mechanics*).

THE traction, moment-twist relation, torsional compliances, and frictional energy loss per cycle are computed for two like, elastic spheres in Hertz contact acted upon by a small oscillating torsional couple.

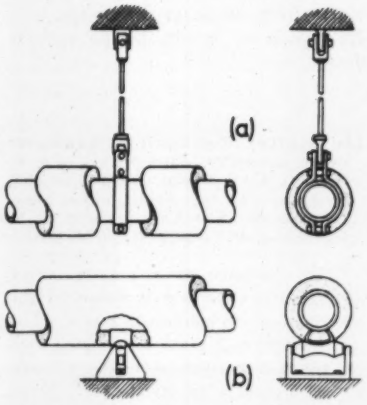
Transmission of Tension From a Bar to a Plate, by J. N. Goodier, Mem. ASME, Stanford University, Stanford, Calif., and C. S. Hsu, International Business Machines Corp., Poughkeepsie, N. Y. 1953 ASME Annual Meeting paper No. 53—A-41 (in type; to be published in the *Journal of Applied Mechanics*).

WHEN a bar or strip is lap-jointed to a plate and transmits tension to it, the transmission is not effected only by a smooth distribution of force along the lap joint; there is also a highly concentrated force, a considerable fraction of the total tension, where the bar meets the plate, and a second force at the end of the bar. These forces are investigated by strain-gage measurements for various lengths of lap, and by a plane-stress calculation, with fair agreement.

The results suggest that the fatigue strength of such joints will depend on the detailed local character of the joint where the bar meets the plate, rather than on the length of the joint.

Flexibility of Piping Systems Supported by Equally Spaced Rigid Hangers, by J. E. Brock, Mem. ASME, Midwest Piping Company, Inc., St. Louis, Mo. 1953 ASME Annual Meeting paper No. 53—A-6 (in type; to be published in the *Journal of Applied Mechanics*).

EXACT methods are developed for the analysis of single-plane piping configura-



TYPICAL PIPE-HANGER BEAMS

tions in which there occur long horizontal runs supported on equally spaced hangers of rigid type. Two important cases are treated in detail and are illustrated by examples.

On the Thickness of Normal Shock Waves in a Perfect Gas, by A. H. Shapiro, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass., and S. J. Kline, Assoc. Mem. ASME, Stanford University, Stanford, Calif. 1953 ASME Annual Meeting paper No. 53—A-35 (in type; to be published in the *Journal of Applied Mechanics*).

AN approximate method for calculating the thickness of shocks in perfect gases, similar to the integral methods of ordinary boundary-layer theory, is formulated and leads to an explicit formula relating a shock-thickness Reynolds number to the Prandtl number, ratio of specific heats, and Mach number entering the shock. The method takes account of the variation of viscosity with temperature.

The results of the approximate theory are in exact accord with the known exact solutions for (*a*) the case where the Prandtl number is $^3/_4$ and the viscosity and heat conductivity are constant, (*b*) the case where the shock is very weak, and

(*c*) the case where the gas has finite viscosity but zero conductivity.

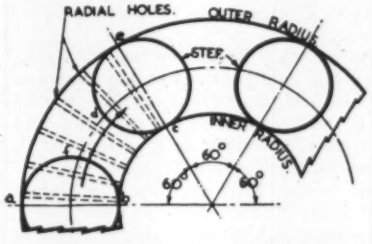
In addition, the approximate theory is in good agreement with results obtained on a differential analyzer showing the effects of Prandtl number and variation of viscosity with temperature. The results also are expressed in terms of the ratio of shock thickness to mean free molecular path in the inlet gas. This ratio is given in terms of the Prandtl number, ratio of specific heats, and shock strength. In the absence of relaxation effects, the numerical magnitudes suggest that the continuum theory is accurate for inlet Mach numbers below about 1.5, whereas for higher Mach numbers the continuum theory is indicative of general orders of magnitude.

Experimental Measurement of Mechanical Impedance or Mobility, by R. Plunkett, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1953 ASME Annual Meeting paper No. **53—A-45** (in type; to be published in the *Journal of Applied Mechanics*).

A DEVICE for the experimental measurement of mechanical impedance as a function of frequency is described. The measured values for two systems are shown. It is also shown that the performance of a modified system may be predicted in some respects. These measurements show that this function is extremely complex and that the systems are very limber at audio frequencies.

The Stepped Thrust Bearing—A Solution by Relaxation Methods, by C. F. Kettleborough, University of Melbourne, Melbourne, Australia. 1953 ASME Annual Meeting paper No. **53—A-9** (in type; to be published in the *Journal of Applied Mechanics*).

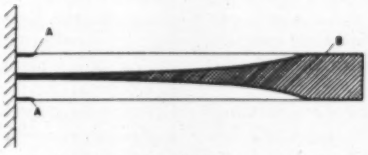
ANALYTICAL investigation into the stepped thrust bearing was first carried out by Lord Rayleigh, whose solution neglected side leakage. More recently Archibald has presented a solution with side leakage not neglected but limited by the step being straight across the bearing surface perpendicular to the direction of motion. This paper gives an alternative solution, using relaxation methods, which is applicable to any shape of the step. Results show that the load capacity of the completely internal step is much greater than that for the simple tilting slider.



SUGGESTED PRACTICAL STEPPED THRUST BEARING

A Method for Determining the Internal Damping of Machine Members, by A. W. Cochardt, Westinghouse Research Laboratories, East Pittsburgh, Pa. 1953 ASME Annual Meeting paper No. **53—A-44** (in type; to be published in the *Journal of Applied Mechanics*).

A METHOD is described by which the internal damping of a machine member can be evaluated in a simple way. It is shown that the results of a conventional damping test on a simple shaped specimen of the chosen material can be combined with a newly introduced quantity, the stress-distribution function, to yield the internal damping of a particular member. The suggested method eliminates the necessity for testing expensive specimens as was often the practice.



A = Stress between 90 and 100 per cent of maximum
B = Stress between 0 and 10 per cent of maximum.

A HIGH AND A LOW-STRESS INTERVAL IN A CANTILEVER BEAM

On Application of a Quasi-Static Variational Principle to a System With Damping, by Morris Morduchow, Polytechnic Institute of Brooklyn, Brooklyn, N. Y. 1953 ASME Annual Meeting paper No. **53—A-3** (in type; to be published in the *Journal of Applied Mechanics*).

THE principal bending modes of vibration of a beam with a damping force proportional to the velocity are considered. It is shown that, in an important class of cases, the damping has exactly no effect on the mode shapes. It is further shown that the linear differential equation for the vibrating beam with damping can be transformed mathematically into a stationary condition after eliminating the time as a variable. Application of the Rayleigh method to this condition then leads to general approximate results for the logarithmic decrement, and for the effect of damping on the natural frequency, not only in the fundamental mode, but also in any higher principal mode.

ASME Transactions for December, 1953

THE December, 1953, issue of the Transactions of the ASME, which is the *Journal of Applied Mechanics* (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following technical papers:

Limit Analysis of Punch Indentation, by R. T. Shield and D. C. Drucker. (53—APM-21)

Transverse Impact on Beams and Plates, by A. C. Eringen. (53—APM-27)

Buckling of Reinforced Cylindrical Shells, by W. A. Nash. (53—APM-29)

Dynamic Load Characteristics in Plastic Bending of Beams, by P. S. Symonds. (53—APM-26)

Analog Solution for Beams Excited by an Arbitrary Force, by W. T. Thomson and T. A. Rogers. (53—APM-13)

Thermal Stress in Pipes, by Henry Parkus. (53—APM-19)

Solutions of Heat-Conduction Problem With the Aid of the Inverse Method, by F. S. Weinig. (53—APM-25)

Toroidal-Shell Expansion Joints, by N. C. Dahl. (53—APM-30)

Flexural Vibrations in Uniform Beams According to the Timoshenko Theory, by R. A. Anderson. (53—SA-9)

Flexural Wave Solutions of Coupled Equations, by Julius Miklowitz. (53—SA-6)

Analysis of a Nonlinear Dynamic Vibration Absorber, by L. A. Pipes. (53—SA-41)

Constant-Strain Waves in Strings, by J. D. Cole, C. B. Dougherty, and J. H. Huth. (53—SA-4)

Dynamic Stress-Strain Relations for Compression Impact, by J. E. Johnson, D. S. Wood, and D. S. Clark. (53—SA-7)

The Effect of Strain Hardening in an Annular Slab, by P. G. Hodge, Jr. (53—SA-20)

The Rate of Growth of Vapor Bubbles in Superheated Water, by Paul Dergarabedian. (53—SA-10)

On Reinforced Circular Cutouts, by E. Levin. (53—SA-11)

Torsional Stiffness Under Tension, Compression, and Bending, by H. L. Engel and J. N. Goodier. (53—SA-5)

BRIEF NOTES

The Complex-Variable Approach to Stress Singularities, by J. H. Huth.

Note on the Maximum Effect of a Moving Force on a Simple Beam, by E. S. Eichmann.

A Resistor-Network Solution for the Torsion of Hollow Sections, by J. H. Weiner.

Closed-Form Solutions for Plates of Variable Thickness, by H. D. Conway.

A Note on Mass Flow, by E. C. Kennedy.

Diametral Expansion of Helical Compression Springs During Deflection, by A. M. Wahl.

Additional Data on the Relaxation Type of Vehicle Suspension, by Joseph Gallagher and Enrico Volterra.

Note on Torsional Oscillation of I-Type Beams, by J. E. Goldberg.

Concentrated Radial Loads on Flat Curved Beams, by J. N. Goodier and J. C. Wilhoit, Jr.

DISCUSSION

BOOK REVIEWS

THE ASME COUNCIL

Reports Activities in 1952-1953

THE SOCIETY year just ended was a good year. It was marked by fine technical programs, expanded publications, sound progress in research, standards, and codes, improved activity in the Sections and Student Branches, an increase in membership, and a most satisfactory increase in income from publications. There was a broadening of ASME leadership internationally, particularly in the fields of codes and standards. Through EJC and ECPD, the joint bodies in which ASME is active, there was some progress toward unity of the profession and a realization that engineering education standards must be raised. Problems, not new, now drawn into sharper focus include modification in the methods of organizing and conducting meetings, improvements in publications, particularly their distribution, and the need for closer relations between the Council and those concerned with the technical life of the Society.

Excellent opportunity for the members to meet and exchange experience was provided by four National Meetings, six Professional Division Conferences, a Regional Meeting, and 1006 meetings of Sections. The 135 Student Branches reported 643 meetings and conducted 12 Regional Student Conferences in which hundreds of students participated.

Table 1, which gives the statistics for National Meetings and Professional Division Conferences, shows an attendance more than 30 per cent greater than for 1951–1952 and reveals an Annual Meeting attendance of 7270, the largest ever recorded.

NATIONAL MEETINGS AND CONFERENCES FEATURE PROMINENT SPEAKERS AND EXCELLENT PROGRAMS

Highlighted at every meeting were prominent speakers from industry, government, and education who delivered significant talks on timely subjects to large audiences of interested engineers. Frederick S. Blackall, jr., president ASME, made an important address at each National Meeting and at three conferences during his term. Three leaders in different fields delivered Roy V. Wright Lectures. They were Alfred H. Williams, president, Federal Reserve Bank of Philadelphia; Frank J. Lausche, Governor of Ohio; and Carey H. Brown, Eastman Kodak Company, Rochester, N. Y. The Calvin W. Rice Lecture was delivered by J. Foster Petree, editor, *Engineering*, London, England. Some of the other prominent men who spoke at luncheons and dinners during the meetings were: Charles F. Kettering, Fellow ASME, research consultant, General Motors Corporation; The Honorable Robert Winters, Minister of Public Works, Ottawa, Ontario, Canada; Lieut. Gen. Ernest O. Thompson, chairman of the Texas Railroad Commission; Under Secretary of the Air Force, Roswell L. Gilpatric; L. A. DuBridge, president of the California Institute of Technology, Pasadena, Calif.; Prof. S. P. Timoshenko, Fellow ASME, international authority in the field of applied mechanics; and Gerard Piel, publisher of *The Scientific American*.

The year saw the resumption of the Lectureship Program in full scale. Seven eminent lecturers appeared before 36 Sections. The lecturers were: Earle Buckingham, J. P. Den Hartog, C. O. Dohrenwend, Charles Lipson, Glenn Murphy, Jesse Ormondroyd, and Irwin Vigness.

The programs of the meetings offered a wide variety of technical papers, data, reports, panel discussions, and symposiums, covering numerous engineering developments and accomplishments in the broad field of mechanical engineering.

At the 1952 Annual Meeting, for example, the symposium on the government's $500,000,000 heavy-press program for light metals created great interest. The symposium, sponsored jointly by the Aviation, Machine Design, and Metals Engineering Divisions of ASME, SAE, AIME, and IAS, emphasized to aircraft-design engineers the need for the expanded utilization of larger and more complex forged and extruded structural components in forward aircraft designs.

For those engineers interested in obtaining useful power from the atom, the Heat Transfer Division presented reports on a liquid-metal heat-transfer and steam-generation system for a nuclear-power plant and also on the design and performance of liquid-metal heat exchangers. In addition, the Hydraulic Division discussed electromagnetic and mechanical pumps for high-temperature liquid metals for use in atomic plants. Some of these pumps, which must be leakless and highly dependable, were described.

Automation, a subject which is stirring the imagination of many of our engineers, was discussed at joint sessions of the Management, Instruments and Regulators, Materials Handling, Safety, and Production Engineering Divisions, and the Junior Committee. Progress in automatic production, the future of automatic machinery, material transfer between steps in an automatic process, the application of analog computers and similar equipment to process-control problems, and control problems in an automatic chemical or petroleum plant were covered.

Other high lights of the Annual Meeting included an Air Cargo Day, a symposium on air-pollution control, and the 1952 ASME Ten-Year Progress in Management report.

During the 1953 Spring Meeting, noteworthy technical presentations included papers on centrifugal and free-piston-type turbines by the Gas Turbine Power Division; data on materials such as Teflon, unplasticized polyvinyl chloride, metal-clad laminates used in printed circuitry, reinforced plastics, and molded rubber, by the Rubber and Plastics Division; and developments in electrospark machining by the Production Engineering Division and Metal Processing Committee.

Of note also was the scheduling during the past year of the first annual Engineering Management Conference sponsored by the ASME Management Division. Top-management programs concerning engineering activities, effective engineering, and selection, training, and supervision of engineers were discussed.

A significant contribution made by the Applied Mechanics Division was the symposium on digital and analog computers and computing methods held during the annual Applied Mechanics Conference of the Division. It was concerned with the present status of high-speed computing apparatus and its sphere of usefulness in scientific and industrial applications.

Sessions at the Semi-Annual Meeting covered important engineering subjects such as: Development of ramjet power, turbocompressors, propulsion, wind tunnels, artillery rockets, the smokeless burning of waste process gases, and nuclear power plants.

The six sessions of the Heat Transfer and Fluid Mechanics Institute held in conjunction with and under the auspices of the ASME Heat Transfer Division at this meeting brought forth much important information on heat transfer in various applications, studies of shock wave, factors that influence heat transfer, Professor Moore's fluid-flow analogs for solving heat-conduction problems, cavitation, the theory of flame propagation, stability of heterogeneous systems, and evaporation from liquid-wall films into a turbulent gas stream.

Of great interest was the symposium on "Production Weighing and Control" which was presented by the Instruments and Regulators Division during the ISA Conference and Exhibit. Topics covered various phases of production weighing, including high-speed weighing, continuous-weighing meters and feeds, batch weighing, and electronic weight determination.

With a record number in attendance, the Petroleum Division Conference covered subjects of major interest to petroleum engineers such as refining, pipe lines, production and drilling, materials, and manufacturing.

An abundance of engineering material which covered a wide scope was offered during the Fall Meeting. A technical high spot was the Symposium on Industrial Uses of Photography and Optical Instruments, sponsored by the ASME Rochester Section.

Conveyers, according to a Materials Handling Division paper, are now being developed to perform complex operations, with emphasis on automation, created by the need for cost reduction and increased production, with uniform improved quality. Along similar lines, a paper presented during a Machine Design Division Session gave an illustration of automatic assembly.

A Fuels Division paper described coal-handling facilities which are being designed with automatic remote-control features. Lower installation and operating costs are expected to result.

TABLE 1 NATIONAL MEETINGS AND CONFERENCES 1952–1953

Meetings	Days	Number of Sessions	Papers	Preprints	Attendance
Fuels Conference Oct. 30–31, 1952, Phila., Pa.	2	4	12	2	203
Annual Meeting Nov. 30–Dec. 5, 1952, N. Y., N. Y.	5	96	223	170	7270
Management Conference Apr. 15–16, 1953, Detroit, Mich.	2	4	11	10	440
Spring Meeting April 28–30, 1953, Columbus, Ohio	3	26	69	47	937
Oil and Gas Power Conference May 24–28, 1953, Milwaukee, Wis.	4	5	8	8	410
Applied Mechanics Conference June 18–20, 1953, Minneapolis, Minnesota	3	8	36	36	212
Semi-Annual Meeting June 28–July 2, 1953, Los Angeles, California	4	41	100	78	1604
Instruments and Regulators Conference Sept. 21–25, 1953, Chicago, Ill.	2	4	14	14	300
Petroleum Mechanical Engineering Conference, Sept. 28–30, 1953, Houston, Texas	3	18	36	34	833
Fall Meeting Oct. 5–7, 1953, Rochester, N. Y.	3	20	44	33	750
	31	226	553	432	12959

Plans for the celebration of 1955 as the 75th year of the Society were initiated and a preliminary appropriation of the necessary funds was authorized.

IMPROVEMENTS IN QUALITY OF MEETINGS AND PAPERS

The Society's program-making procedures pose serious problems. Technical developments in the fields of the Society's current and traditional interests have resulted in a rapidly increasing number of sessions and papers and an ever-widening diversity of subject matter demanding attention. In addition, new fields of subject matter, some of them outside the scope of ASME program-making agencies, as at present constituted, but of great future importance to mechanical engineers, should be developed and brought to the notice of our members. Failure of the Society actively to develop rapidly expanding areas on the frontiers of mechanical engineering or to exercise aggressive leadership in traditional areas, leads to disservice to members and the formation of splinter societies of specialists. The essentially autonomous character of the Society's numerous program-making agencies tends to foster nonuniform criteria for the quality of papers accepted for presentation, sometimes inferior performance in the conduct of technical sessions, and nonuniform practices and standards in the review of papers recommended for publication.

As a start in the better control of these problems, the Council adopted a policy prepared by the Board on Technology which puts emphasis on earlier planning, on a clearer sense of responsibility by program-making agencies, and on a more discriminating review of papers before presentation and before publication. The policy requires far-reaching changes and will not have full effect until the next succeeding year.

Specific improvements in meeting procedures effected during the year were the distribution of advance programs to all members and improvements in the format of advance programs and papers.

SURVEY OF SOCIETY PUBLICATIONS UNDER WAY

The form, content, and distribution of Society publications has been subject to question.

The problem was presented at the 1952 Annual Meeting and has had continuous consideration. As a step toward its solution, the Publications Committee initiated a comprehensive study of Society periodical publications and its preprint procedure. When complete, the study will include a survey of members' views on MECHANICAL ENGINEERING and preprint procedures. On recommendation of the Publications Committee the Executive Committee of the Council voted to send every member ten free coupons which may be exchanged for preprints in stock. These coupons were sent out in August, 1953, with the members' bills for dues.

The volume of publications exceeded that of previous years; 2500 pages appeared in Transactions and 1050 pages in MECHANICAL ENGINEERING. Thirty-six new publications were issued, bringing the titles in stock to 257. New titles included autobiographies of Dexter S. Kimball and W. F. Durand. The final section of the Glossary of Nuclear Energy appeared. Over 140,000 copies of technical papers were distributed and the number of subscriptions to Transactions was doubled. The volume of publication sales exceeded $300,000, largest in our history, and advertising income increased about 20 per cent over the preceding year.

Applied Mechanics Reviews continues with an improved editorial content. It maintained its subscription list and is receiving slightly more industrial support and continuing government support.

PROFESSIONAL DIVISIONS

All the Professional Divisions had fruitful years as was evidenced by active participation in programs of the National Meetings and of the Professional Division Conferences. The need for closer relationship between the leaders in Professional Divisions and the Council was recognized during the year and progress made toward a solution of the problem. As an interim measure, an Administrative Conference of Professional Division representatives and the Council is being held during the 1953 Annual Meeting.

SOCIETY RESEARCH PROGRAM REORGANIZED

In an effort to make its research program of even greater service, the Society has reorganized the planning and administrative structure of this activity. These changes should result in an expansion of this unique and valuable service. Particularly important will be the new Research Planning Committee. Presently active are 13 research committees, some of which act jointly with other technical organizations. From the sponsored projects, definite progress was reported on lubrication, high-temperature steam generation, and effect of temperature on the properties of metals. Definite research projects were in the late planning stage for heat-conduction charts and mechanical pressure elements.

ASME CODES AND STANDARDS

The Board on Codes and Standards approved 24 new codes and standards and reported that 14 standards, for which ASME has sponsorship under the American Standards Association procedure, had been reviewed and as no change was deemed necessary had been presented to ASA for affirmation.

The Boiler Code Committee held a meeting at Portland, Ore., on April 30, 1953, jointly with the National Board of Boiler and Pressure Vessel Inspectors, preceded by a two-day panel session on all phases of the committee work. An attendance of 300 measured the importance of boiler and pressure-vessel code problems in the Northwest U.S.A. and West Canada.

In standards, the revision of the American Standard for Steel Pipe Flanges and the proposed American Standard National Plumbing Code represent major achievements on the part of the committees. In particular, the Plumbing Code represents an agreement among the eight major groups in the country which previously had sponsored their own different codes.

Internationally, the work of ASME in all fields of codes and standards is taking on increasingly new importance.

INTERNATIONAL CODES AND STANDARDS

The Boiler Code Committee holds the secretariat of TC11, a project of the International Organization for Standardization, dealing with international rules for boilers. TC11 met in Paris, May 12–20, 1953, with H. B. Oatley, chairman of the ASME Boiler Code Committee, presiding over a gathering of 80 delegates from 11 nations which joined in the view that international agreement is essential. Working Subcommittees on Materials, Allowable Stresses and Design Formulas, and on Welding will carry on with the hope that a second meeting of TC11 may be held in 1955 to finalize the discussions.

There has been a resurgence of interest in the American-British-Canadian standards-unification program. Study groups appointed at the 1952 ABC conference have been at work in the three countries on screw threads, limits and fits, and drafting practice with a view to furthering interchangeability. In ABC discussions, misunderstanding arose due to nonuniform terminology and, therefore, the ASME Standardization Committee authorized a co-ordinating committee of representatives from Sectional Committees on Screw Threads, Pipe Threads, Limits and Fits, and Drafting Practice, to develop a proposal on general terminology in the fields covered by these committees. Four years' experience has indicated the need for minor refinements and work is being pursued energetically. Increased use of the Standard on Square and Hexagon Bolts and Nuts has indicated the desirability of an improved format to encourage its use.

The International Electrotechnical Commission convenes in Philadelphia in September, 1954, for its Jubilee meeting. ASME Power Test Codes Committee holds the Secretariat for three IEC projects, Steam Turbines, Hydraulic Turbines, and Internal-Combustion Engines, all dealing with acceptance testing. Good progress was made in all three fields preparatory to the Philadelphia meeting.

SOCIETY ACTIVITIES IN THE REGIONS

The eight regions, each with a Vice-President, are concerned with the Society activities and services which must be made available to the members through the Sections and to the Student Members through the Student Branches. This pattern of regional organization has been in effect for eight years and has become established as a useful pattern.

The eight Vice-Presidents report healthy activities in the Sections and Student Branches and most successful Student Branch Conferences. There is evidence of increased interest by engineers in participation in civic affairs. Continued attention is being directed to unity in the profession. Better average attendance at local meetings is reported in several regions. As a means of insuring closer co-operation between Sections and Student Branches, the Council authorized each Section to appoint an outstanding engineer as a Student Branch Councilor for each Student Branch in the area of the Section.

The following special regional activities are worthy of note:

Region I is placing particular emphasis on increasing the percentage of members active in Section work.

Region II, formerly only the Metropolitan Section, is taking on a truly regional atmosphere with the addition of the Plainfield Section and the formation of the Long Island, Mid-Hudson, and Northern New Jersey Subsections.

TABLE 2 CHANGES IN MEMBERSHIP

	Membership		Increases (Sept. 30, 1952, to Sept. 30, 1953)			Decreases (Sept. 30, 1952, to Sept. 30, 1953)				Changes (Sept. 30, 1952, to Sept. 30, 1953)		
	Sept. 30, 1953	Sept. 30, 1952	Transferred to	Elected	Reinstated	Transferred from	Resigned	Dropped	Died	Increases	Decreases	Net change
Honorary	53	54	4						5	4	5	− 1
Fellows	379	380	24			3			22	24	25	− 1
Members	13856	13429	294	580	104	25	81	272	173	978	551	+ 427
Associates	336	352	1	11	1	3	5	13	8	13	29	− 16
Junior (25)	3357	3207	575	61	37	193	46	277	7	673	523	+ 150
Junior (20)	1993	1876	910	68	29	644	36	210		1007	890	+ 117
Junior (10)	18489	18147		2619	60	940	118	1262	17	2679	2337	+ 342
Totals	38463	37445	1808	3339	231	1808	286	2034	232	5378	4360	+1018

Region III reports one Student Branch, Swarthmore College, with 100 per cent of those eligible as Student Members, and unusually large participation in the Charles T. Main Award competition, the winner coming from Region III. Seven Sections in Region III are carrying on active programs devoted to the special interests of the members in the Sections.

Region V reports one Student Branch, the University of Dayton, with 100 per cent of those eligible as Student Members.

Region VII reports three new Sections, Columbia Basin, San Diego, and Hawaii.

Region VIII reports a successful succession of Regional meetings and the continuation of the Mexico Section for a further experimental period.

Representatives of each Section meet with the Vice-President each spring as a Regional Administrative Committee. Delegates from these meetings gather in a Regional Delegates Conference held just prior to the Semi-Annual Meeting to discuss questions that have previously been discussed at the Regional meetings. The deliberations of the Regional Delegates Conference present a consolidated viewpoint to the Council. The 1953 Regional Delegates Conference was held at Los Angeles and its recommendations on several Society policies and procedures were presented to the Council. These recommendations are reviewed by the appropriate Society committees prior to formal action by the Council thereon. Actions on the recommendations of the 1952 Regional Delegates Conference were completed in October, 1952.

ASME RELATIONS WITH OTHER ORGANIZATIONS

One of the distinguishing characteristics of the ASME program of activities is the variety and extent of its co-operation with engineers and scientists in U.S.A. and abroad. This co-operation is concrete evidence of unity of aspiration, a valuable element in unity of organization. Although this program of co-operation is effective, it is not generally understood. As an aid to understanding, therefore, progress will be reported under the following headings under which the over-all pattern of co-operation may be analyzed.

ASME CO-OPERATES WITH OTHER SOCIETIES

Brief mention should be made of many ways in which ASME co-operates with other engineering societies:

1 In expressing the views of the profession on matters of public interest. The agency for this co-operation is Engineers Joint Council.

2 In improving the process of selecting, educating, training, and recognizing the attainments of the engineer. The agency is the Engineers' Council for Professional Development. Its scope is concerned with the engineering profession while that of EJC deals largely with the public.

3 In advancing the arts and science of engineering. In this, ASME is actively engaged in more than a dozen efforts jointly with other agencies and lends its support to many more.

4 In providing joint headquarters facilities and safeguarding joint assets. United Engineering Trustees, Inc., is the agency charged with this responsibility.

5 In bestowing honors for distinguished achievement. ASME has eight such activities.

6 In a national and international program of standardization through American Standards Association. The years' events in these areas have already been mentioned in this report.

7 In providing services for our members through two joint bodies—ESPS and NBER.

CO-OPERATION IN THE PUBLIC INTEREST THROUGH ENGINEERS JOINT COUNCIL

During the year EJC took the first steps toward unity in the engineering profession by adding three engineering societies to its membership and revising the EJC Constitution. It recommended to the Congress changes in the Atomic Energy Act to permit maximum contribution by the engineering profession in the development of atomic energy for peacetime purposes. The international activities of the western hemisphere were advanced by the incorporation of the UPADI Fund (Pan American Federation of Engineering Societies) which clears the way for contributions to be received for the financial support of the activities of UPADI. The National Water Policy Panel contributed to the plans for the program for the December Mid-Century Conference on Resources for the Future. The Labor Legislation Panel appeared before the proper Congressional committees and urged the retention of the provisions of the Taft-Hartley Act relating to professional personnel.

CO-OPERATION IN THE ENGINEER'S EDUCATION—ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT

A new guidance booklet, "Engineering—A Creative Profession," was issued.

The accreditation program, which has been very active, has been under critical review. The accrediting questionnaire and manual for inspection have been revised. The need for raising accrediting standards has been accepted and ways and means are under discussion. As a step, ASME accepted the ECPD invitation to contribute, with other Societies, to the study being made by the American Society for Engineering Education on the Evaluation of Engineering Education.

Good progress is reported on the program for "Five Years of Professional Development" for the young engineer, initiated in Cincinnati in co-operation with industry, the University of Cincinnati, and the local engineering society. A full report on this project will be made at the 1954 Annual Meeting of ECPD in Cincinnati.

CO-OPERATION IN ADVANCING ENGINEERING SCIENCE

Engineering Societies Library. A collection of 170,000 bound volumes and 1400 current periodicals. During 1952–1953 ESL provided 60,000 photoprints and 300,000 words of translation and answered 37,749 requests for service. ESL sponsors the Engineering Societies Monograph Series.

The Engineering Foundation. Supports research and advances profession of engineering. In 1952–1953 the Foundation supported ECPD and five ASME projects: (*a*) lubrication, (*b*) effect of temperature on properties of metals, (*c*) properties of gases, (*d*) high-temperature steam generation, and (*e*) *Applied Mechanics Reviews*.

Section "M" Engineering—American Association for the Advancement of Science. Provides opportunity for cross-fertilization with other fields of science. In 1952–1953, engineering participation was revitalized.

Council for International Progress in Management. The U. S. National Committee for the International Committee on Scientific Management. In 1952–1953, it provided for interchange of management engineers with European countries and perfected plans for International Congress in São Paulo, Brazil.

U. S. Committee on Theoretical and Applied Mechanics. U. S. A. representative on the International Union of Theoretical and Applied Mechanics. Authorized second U. S. Congress on Applied Mechanics at Ann Arbor, Mich., June, 1954

World Power Conference. No activity for ASME this year.

International Organization for Standards. Referred to under "International Codes and Standards."

International Electrotechnical Commission. Referred to under "International Codes and Standards."

The Institution of Mechanical Engineers (London). ASME has an active program of engineering co-operation with IME, including simultaneous presentation of papers. A joint sponsorship of international discussion on combustion is planned for 1955.

ASME-EIC International Council. A joint body charged with developing mutuality of interests of the Engineering Institute of Canada and ASME. In 1952–1953 it secured Canadian personnel for ASME committees and furthered Canadian participation in ASME Fall Meeting.

API-ASME Unfired Pressure Vessels. Sponsored joint code whose continuance is under discussion.

National Research Council. ASME participates in the Division of Engineering and Industrial Research. In 1952–1953 there was no important activity of interest to ASME.

American Rocket Society. Affiliated with ASME. In 1952–1953 there was extensive participation by ARS in ASME Annual and Semi-Annual meetings.

EUSEC (Conference of Engineering Societies of Western Europe and U.S.A.). Made up of 18 societies, five from U.S.A. In 1952–1953 EUSEC made important progress on problems relating to engineering education. Other projects include abstracting of engineering literature and terminology. ASME was represented at the meeting in Paris by Secretary Davies.

CO-OPERATION IN JOINT BUILDING

United Engineering Trustees, Inc., holds the Engineering Societies Building and administers The Engineering Foundation and the Engineering Societies Library. The building is inadequate and obsolescent as a national engineering center. Active work is under way for a new building. Such a new building, conceived in co-operation with all engineering groups as a great engineering center, will be a concrete contribution to the unity of the profession.

CO-OPERATION IN SERVICE

Engineering Societies Personnel Service, Inc. A placement service for engineers, listed 1800 positions open on Sept. 30, 1953.

National Bureau of Engineering Registration. An agency of the National Council of State Boards of Engineering Examiners to facilitate multiple-state registration of qualified professional engineers. In 1952–1953, 136 applications for certification were received.

ASME WOMAN'S AUXILIARY

The ASME Woman's Auxiliary reports a membership of 1155 and 17 sections, two new ones having been formed during the year at Iowa-Illinois and Nebraska. The Calvin W. Rice scholarship was awarded to a student from Turkey and the first award of the Sylvia W. Farny scholarship was made to a student at the University of Akron. The Student Loan Fund has $7000 in loans outstanding.

THE COUNCIL AND THE SECRETARY'S STAFF

Council and Vice-Presidents' Meetings. The Council met twice during the year, at the Annual Meeting in New York, November 30–December 1, 1952, and at the Semi-Annual Meeting in Los Angeles, June 28–29, 1953. The Executive Committee of the Council held eight meetings, including one during the Spring Meeting in Columbus, Ohio, April 29, 1953, and one during the Fall Meeting in Rochester, October 6, 1953. Meetings of the Vice-Presidents were held December 2, 1952, New York; February 18, 1953, New York; and June 29–30, 1953, in Los Angeles.

President's Visits. At the close of his administrative year, the President will have attended meetings of 17 Sections and 12 Student Branches. In addition, he attended the Annual Meeting in New York, the Spring Meeting in Columbus, the Semi-Annual Meeting in Los Angeles, and the Fall Meeting in Rochester; also conference of the Management Division in Detroit, conference of the Oil and Gas Power Division in Milwaukee, Petroleum Mechanical Engineering Conference in Houston, Management Conference in Skytop, Pa., and Joint Fuels Conference, Chicago.

Deaths. Two Past-Presidents who were also Honorary Members died during the year—Dexter S. Kimball, November 1, 1952, and Harvey N. Davis, December 3, 1952. Also the following past officers: John Hunter, February 5, 1953, Spencer Miller, Sr., June 16, 1953, Walter S. Finlay, Jr., June 17, 1953, and Arthur M. Greene, Jr., September 2, 1953; the latter was also Honorary Member of the Society. Gano Dunn, Honorary Member, died April 10, 1953.

Secretary's Staff. At the end of the year, in addition to his duties as meetings manager, O. B. Schier, 2nd, assumed the duties of field manager supervising the staff work on Sections, Student Branches, Membership, and Honors formerly handled by Ernest Hartford. Mr. Hartford as deputy secretary is performing special staff duties. Mr. Schier was appointed an assistant secretary by the Council.

Two members of the staff died during the year—Harry W. Edwards, office manager, on May 26, 1953, and Harry R. Cobleigh of the editorial staff, on May 28, 1953.

Frances Selig completed forty-five years on the staff; Katherine W. Clendinning and Louise J. Reinschmidt, thirty-five years; and Roy T. Modica, twenty-five years.

Walter Letroadec was appointed office manager and assumed his duties on August 4, 1953.

SERVICES OF ASME COMMITTEES

At this point, it is imperative that the Council express its appreciation for the enthusiastic support of the countless members that has made the foregoing good report possible. There are many others who devote painstaking attention to the innumerable tasks of Society administration, whose names do not appear in the headlines but who are making an invaluable contribution to the advance of the Society. A mention and a word of appreciation is in order.

Finance Committee, whose work results in our financial stability, reported in a following document.

Organization Committee, which scrutinizes committee appointments for the Council, reviews all organization problems, and which is presently tackling a fundamental problem of Council organization.

Constitution and By-Laws Committee, which painstakingly writes our laws and which in 1952–1953 presented eleven recommendations for Council action.

Board on Education and Professional Status, which in June adopted a clarifying statement on "Ingenuity—Its Place in Undergraduate Education."

Registration Committee, which initiated an active program of education about engineers' registration.

National Junior Committee, which sponsored stimulating forums of junior discussion and initiated a test program for orienting Juniors in Society work.

Board on Membership, which has solved several problems of membership policy.

Admissions Committee, which carefully scrutinized 4622 applications for membership in 1952–1953.

Membership Development Committee, which points to matters of serious concern for Council action.

Membership Review Committee, which considered 453 special cases requiring Council action.

Board on Honors and Medals Committee, which recommended honors recipients to the Council.

Board on Public Affairs, to which Council assigned the responsibility for a Public Relations program.

Civic Affairs Committee, whose program to stimulate members to participate in civic affairs has started to bear fruit.

The Old Guard Committee, which developed an aggressive program to support activities of the Students and the Juniors.

Pension Committee, engaged in a program of modernizing the Society pension plan.

The reports to the Council from all committees and delegates to joint bodies are compiled in a special pamphlet, available on request. A study of it will reveal a great Society carrying on a great work.

1952–1953 COUNCIL

FREDERICK S. BLACKALL, JR., *President*

Past-Presidents

E. G. BAILEY
JAMES M. TODD
JAMES D. CUNNINGHAM
J. CALVIN BROWN
R. J. S. PIGOTT

Vice-Presidents

WILLIS F. THOMPSON
ERNEST H. HANHART
ERNEST S. THEISS
SAMUEL H. GRAF
HENRY R. KESSLER
PAUL R. YOPP
BEN GEORGE ELLIOTT
CLIFFORD H. SHUMAKER

Directors at Large

BENJAMIN P. GRAVES
THOMAS E. PURCELL
LIONEL J. CUCULLU
HAROLD E. MARTIN
ALBERT C. PASINI
DAVID W. R. MORGAN
RALPH L. GOETZENBERGER

ASME FINANCE COMMITTEE REPORT 1952-1953

THE MAJOR duties of the Finance Committee are to prepare the annual budget of the Society and to supervise the expenditure of Society funds. In addition, the Finance Committee is responsible for the investment of all funds of the Society including trust funds, reserves, and surplus. In the discharge of their investment responsibilities, the Finance Committee has the guidance of Scudder, Stevens & Clark, professional investment counsel.

Income and Surplus

The total income of the Society for 1952–1953, was at an all-time high of $1,820,741.12, compared with $1,566,292.64 for 1951–1952; an increase in excess of 15 per cent.

Expenses for 1952–1953 totaled $1,742,490.19. In addition to out-of-pocket expenditures, the Finance Committee, with the approval of the Executive Committee of the Council, established reserves charged against 1952–1953 expenses to provide $20,000 toward the 75th Anniversary Celebration and $16,000 for additional services to members and for other necessary expenses to be incurred in subsequent years. After all charges, net income available for surplus amounted to $78,250.93.

In line with conservative accounting principles, the Society's investments are carried on the books at cost or market value, whichever is lower. The decline in security values during the current year necessitated a charge against surplus of $14,168.53.

In accordance with the suggestion of the Executive Committee, the Contingency Reserve was increased from $600,000 to $675,000 by a charge against surplus. The surplus account after these adjustments and after including initiation and promotion fees amounting to $24,575 shows a balance of $181,334.19. This compares with a surplus of $164,066.45 at the end of the previous year.

The Contingency Reserve shows a balance of $675,000 compared with $600,000 at the end of 1952. The Contingency Reserve is set aside as a cash reserve for use under business conditions which may make it necessary for the Society to operate at a deficit. Approximately 75 per cent of this reserve is invested in U. S. Government Bonds. Also, during the past year, cash balances not needed for current operations have been temporarily invested in 90-day Treasury Bills. The interest earned by so doing amounted to $6,311.84 for the year.

Investments

Custodian, Development, Employees' Retirement and Trust Funds are invested in U. S. Government Bonds or held in cash when required.

Surplus and approximately 25 per cent of the Contingency Reserve are invested in corporate bonds, preferred stocks, and common stocks, in accordance with the investment policy approved by the Council in December, 1950. In reviewing the investments of the Society over the past year, the desirability of selling stocks in general or those which showed a profit and subsequently repurchasing them, was discussed periodically. Investment counsel made the point on numerous occasions that it is impossible to predict, with any certainty, the trends in the security markets. They made the point, however, that if the Finance Committee wished to maintain dollar value, the only way that this could be accomplished would be by selling all corporate securities and returning to the former policy of owning nothing but government bonds. It was pointed out, however, in all of these discussions, that the corporate securities in which the Society's funds are presently invested were those of companies of high investment caliber. The Finance Committee, with full realization of the possibility of a recession in business, believes that for the long pull, the economy of the country is sound and, therefore, decided to continue the December, 1950, investment policy, even though from time to time, the market value of the securities held, declined below their cost. The cost value of the funds in this category was $393,632.98 as of February 3, 1951, when the new policy went into effect.

At that time over 90 per cent of these investments consisted of U. S. Government Bonds. As of September 30, 1953, the funds had a market value of $374,046.50, a book loss of $19,586.48. If these funds had been left invested in government securities, the market value on September 30, 1953, would have been $372,444.25 and the book loss would have been $1,602.25 greater.

Although there was little difference between the market value of the actual investments and what the securities would have been worth if no changes had been made, the income to the Society was increased from a return of 2.8 to 4.1 per cent. The objective of the new policy, which was to maintain purchasing power when prudent to do so has, therefore, been accomplished.

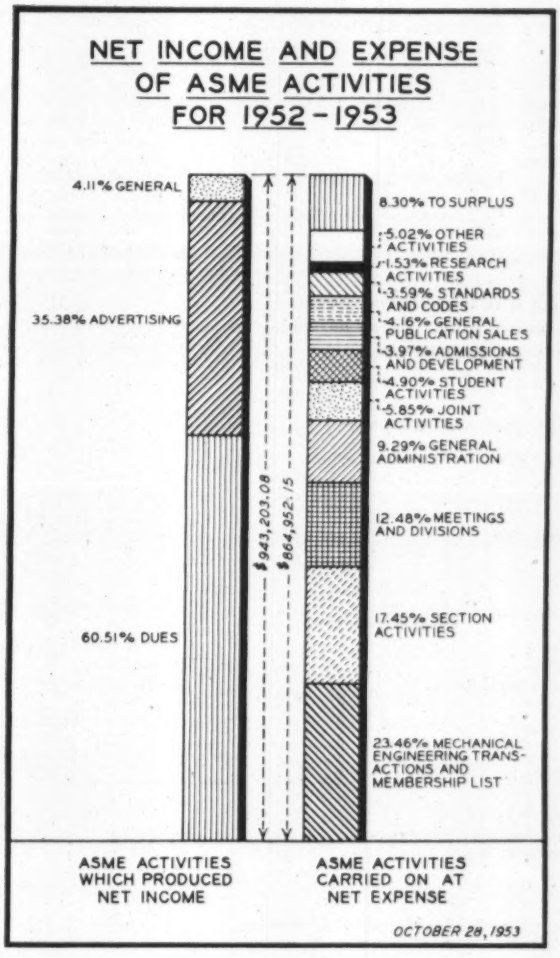
Although the market value of the securities has declined during the past year and is subject to further decline in the event of a recession in business, there is ample buying power available in the Portfolio to take advantage of investment opportunities in common stocks. Only 40 per cent of these funds are invested in this type of security.

The total Security Portfolio as of September 30, 1953, showed a cost of $1,209,877.50 and a market value of $1,243,922.26, including investments of short-term Treasury Bills of $199,012.00.

General

During the year 1953, the Finance Committee, as it has done in the past, has made every effort to manage the funds entrusted to its care in an efficient and economic manner and for the best interests of the Society's members. The members of the Committee have had the complete and wholehearted co-operation of the staff at all times and wish to express their appreciation to them. The Secretary has been particularly helpful in interpreting the objectives of the Society and the Council. The various financial statements made available to the Committee by the Controller have made it possible to conduct the affairs of the Finance Committee with dispatch.

Respectfully submitted,
S. C. WILLIAMS, *Chairman*
J. POPE, *Vice-Chairman*
H. E. MARTIN — J. O. AMSTUZ
L. N. ROWLEY, JR. — A. J. KERR
H. J. BAUER — J. L. KOPF
E. J. KATES



ASME Finances

FINANCES[1]

THE income of the Society for the year of $1,820,741.12 was the largest income in the history of the Society. A net income over expense of $78,250.93 is reported. This amount, plus initiation and transfer fees amounting to $24,575.00 makes a total addition to surplus for the year of $102,825.93.

The balance sheet of September 30, 1953, shows, on that date, that the Society owed:

(1) Current bills and federal tax withheld from employees		$ 16,514.24
(2) Obligations for printing and distributing the 1954 Mechanical Catalog and other bills which have not been submitted		$ 22,346.11
(3) Unexpended appropriations for future services		$ 198,306.14
(4) Future services to members who have prepaid dues		$ 198,700.50
(5) Advertising paid in advance		$ 402.25
		$ 436,269.24

[1] The certified report of the auditors, Price, Waterhouse and Company, is on file in the Society's office and available for inspection by the members.

To meet these debts the Society had:

(1) Cash in the bank		$ 48,049.69
(2) Accounts receivable		$ 146,163.57
(3) Inventories of publications and supplies conservatively valued at		$ 206,129.36
(4) Securities (at the lower of cost or approximate quoted market values)		$ 892,260.81
		$1,292,603.43

The difference between the value held by the Society of $1,292,603.43 and debts of $436,269.24 is the net worth of the Society on September 30, 1953 ..... $ 856,334.19

Against this the Society has set aside a General Reserve against contingencies ..... $ 675,000.00

This leaves a surplus of ..... $ 181,334.19

The Society administers a number of special funds. The condition of these is shown below:

(1) Custodian Funds

Special research and other committees which have collected funds for special services to be expended as needed ..... $ 221,766.54

Against which it had:

(a) Cash	$201,431.02	
(b) Securities (at the lower of cost or approximate quoted market values)	$ 20,335.52	
	$221,766.54	

(2) Development Fund of ..... $ 118,917.79

Against which it had:

(a) Cash	$ 99,667.79	
(b) Securities (at the lower of cost or approximate quoted market values)	$ 19,250.00	
	$118,917.79	

(3) Employees' Retirement Fund of ..... $ 172,078.04

Against which it had:

(a) Cash	$ 34,943.04	
(b) Securities (at the lower of cost or approximate quoted market values)	$137,135.00	
	$172,078.04	

(4) Trust Funds amounting to ..... $ 209,245.04

Against which the Society had the following assets:

(a) Cash	$ 46,665.54	
(b) Securities (at the lower of cost or approximate quoted market values)	$162,459.50	
(c) Notes receivable	$ 120.00	
	$209,245.04	

The Engineering Building is owned jointly by the Founder Societies through United Engineering Trustees, Inc., ASME'S interest, and other long-term assets are treated as a fully reserved fund:

(1) Property Fund of ..... $ 591,316.08

With these assets to support it:

(a) ASME'S quarter interest in real estate and certain other assets of the United Engineering Trustees, Inc....	$498,448.48	
(b) Office furniture and fixtures (depreciated value).....	$ 92,866.60	
(c) Engineering Index, Inc., Title and good will.....	$ 1.00	
	$591,316.08	

Table 3 shows Society operations which produce net income and those which result in net expense. Table 4 shows income and expense by major groupings of Society activities.

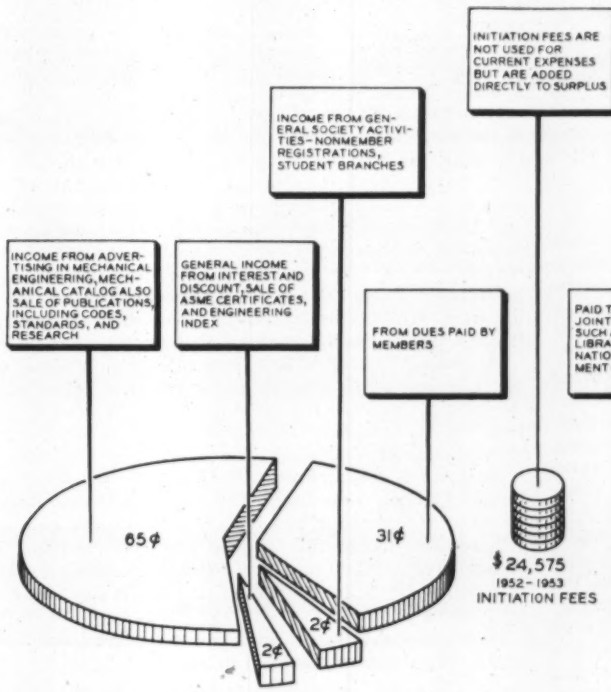
TABLE 3 ANALYSIS OF INCOME AND EXPENSE

(In this analysis, each expense item includes an allocated share of the indirect expense)

A	*Income items against which no charges are made*		
1	Membership Dues		$570,796.45
2	Interest and Discount		29,333.85
3	Miscellaneous Sales		4,895.48
4	Engineering Index, Inc		4,517.44
			$609,543.22
B	*Activities which produce a net income*		
1	Advertising in MECHANICAL ENGINEERING and Mechanical Catalog	$839,591.92	
	Less: Expenses for producing advertising pages and selling the advertising	505,932.06	
			333,659.86
			$943,203.08
C	*Activities with some income which result in a net expense*		
1	General Publication Sales Income	$141,591.47	
	Less: Cost of producing publications sold, mailing cost, and selling cost	180,867.80	
			$ 39,276.33
2	Standards and Codes Income (from sales of publications)	$190,338.21	
	Less: Cost of producing codes and standards sold, mailing cost, selling cost, and servicing of committees	224,187.14	
			33,848.93
3	Research Income (from sales of research reports)	$ 8,358.33	
	Less: Cost of producing research reports sold, mailing cost, selling cost, and servicing research committees	22,760.77	
			14,402.44
4	Student Dues	$ 28,089.00	
	Less: Appropriations to Student Branches, cost of 12 student-branch conferences, cost of copies of MECHANICAL ENGINEERING mailed to Students, and cost of office service	74,269.47	
			46,180.14
5	Meetings Income (from registration fees)	$ 3,228.97	
	Less: Cost of meetings and cost of office service	80,437.76	
			77,208.79
D	*Activities Expense against which no income is credited*		
1	MECHANICAL ENGINEERING text pages (costs of printing and mailing and editorial)		151,497.15
2	Transactions (costs of printing and mailing copies that are not sold and editorial costs)		57,275.38
3	Membership List (cost of compiling, printing, and editorial)		12,575.39
4	Sections (appropriations to Sections, costs of Regional Administrative Committees, cost of Regional Delegates Conference, travel in Regions, costs of office service, and costs of national lectureships)		164,542.08
5	Professional Divisions (appropriations to Professional Division and office costs)		40,496.57
6	Admissions and Development (office costs for Admissions Committee and Membership Development Committee)		37,454.61
7	Awards (cost of medals, prizes, and certificates, and office service)		2,747.12
8	Joint Activities (appropriation for library, ECPD, EJC, etc.)		55,242.87
9	General Administration (expenses of the Council, Retirement Fund, and office service)		87,604.02
10	Society Development (special 1953 appropriation for reserve to broaden service to members in Meetings and Publications)		16,000.00
11	Employment Conditions Questionnaire		3,600.00
12	MECHANICAL ENGINEERING—Reader Interest		5,000.00
13	Society's 75th Anniversary		20,000.00
			$864,952.15
	Net Income		$ 78,250.93

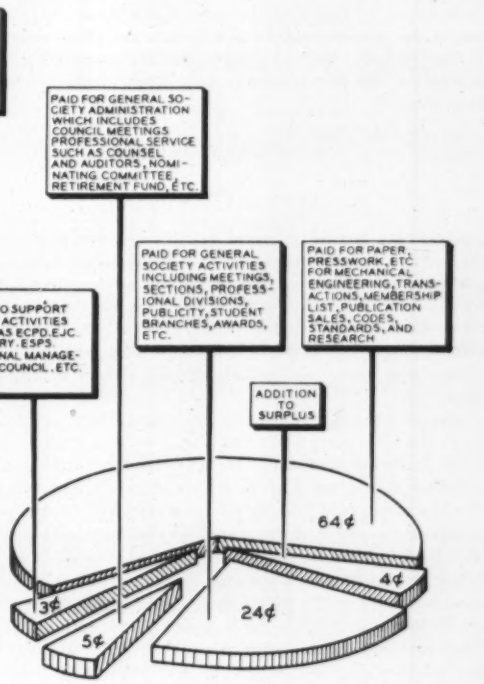
TABLE 4 TOTAL INCOME AND EXPENSE FOR MAJOR GROUPS OF SOCIETY ACTIVITIES

	Expense	Income	Net	Expense per member	Income per member	Net expense per member
Dues	....	$ 570,796.45	+$570,796.45	....	$14.84	....
General Income (interest, discount, emblem sales, Engineering Index, Inc.)	....	38,746.77	+38,746.77	....	1.01	....
Publications, Standards, Codes, and Research	$1,155,095.69	1,179,879.93	+24,784.24	$30.03	30.68	+$ 0.65
General Society Activities (meetings, sections, student branches, admissions, etc.)	444,547.61	31,317.97	—413,229.64	11.56	0.81	10.75
General Society Administration (Council, auditors, counsel, retirement fund)	87,604.02	....	—87,604.02	2.28	....	2.28
Joint Activities (Library, ECPD, EJC, ASEE, etc.)	55,242.87	....	—55,242.87	1.44	....	1.44
Addition to surplus from operating income	78,250.93	....	.....	2.03	....	....
Total	$1,820,741.12	$1,820,741.12	.....	$47.34	$47.34	$13.82
Addition to surplus from initiation fees		24,575.00				
Total addition to surplus		102,825.93				


INCOME FROM ADVERTISING IN MECHANICAL ENGINEERING, MECHANICAL CATALOG ALSO SALE OF PUBLICATIONS, INCLUDING CODES, STANDARDS, AND RESEARCH
GENERAL INCOME FROM INTEREST AND DISCOUNT, SALE OF ASME CERTIFICATES, AND ENGINEERING INDEX
INCOME FROM GENERAL SOCIETY ACTIVITIES—NONMEMBER REGISTRATIONS, STUDENT BRANCHES
FROM DUES PAID BY MEMBERS
INITIATION FEES ARE NOT USED FOR CURRENT EXPENSES BUT ARE ADDED DIRECTLY TO SURPLUS
65¢
31¢
2¢
2¢
$24,575
1952-1953
INITIATION FEES

WHERE ASME INCOME DOLLAR COMES FROM

TOTAL INCOME—1952-1953—$1,820,741.12


PAID FOR GENERAL SOCIETY ADMINISTRATION WHICH INCLUDES COUNCIL MEETINGS PROFESSIONAL SERVICE SUCH AS COUNSEL AND AUDITORS, NOMINATING COMMITTEE, RETIREMENT FUND, ETC.
PAID TO SUPPORT JOINT ACTIVITIES SUCH AS ECPD, EJC LIBRARY, ESPS, NATIONAL MANAGEMENT COUNCIL, ETC.
PAID FOR GENERAL SOCIETY ACTIVITIES INCLUDING MEETINGS, SECTIONS, PROFESSIONAL DIVISIONS, PUBLICITY, STUDENT BRANCHES, AWARDS, ETC.
PAID FOR PAPER, PRESSWORK, ETC FOR MECHANICAL ENGINEERING, TRANSACTIONS, MEMBERSHIP LIST, PUBLICATION SALES, CODES, STANDARDS, AND RESEARCH
ADDITION TO SURPLUS
64¢
4¢
24¢
5¢
3¢

HOW THE ASME INCOME DOLLAR WAS SPENT

TOTAL EXPENSES 1952-1953 — $1,742,490.19*

*ADDITION TO SURPLUS $ 78,250.93

ASME HONORS ENGINEERS

Biographies of Recipients of Honorary Membership and Awards at the 1953 ASME Annual Meeting

EVERY year The American Society of Mechanical Engineers honors distinguished members of the engineering profession by the presentation of certificates of honorary membership and the prizes and awards that have been instituted from time to time during the course of the Society's existence. The bestowal of these certificates, prizes, and awards is a colorful feature of the ASME Annual Banquet where the attendance this year exceeded 1600 persons. A description of the banquet and a list of the recipients of honorary-membership certificates, prizes, and awards will be found on other pages of this issue. In the following pages brief biographies are presented so that members of the Society may know what manner of men they have honored.

HONORARY MEMBERS

EDWARD L. COCHRANE

A notable record as naval architect and marine engineer, coupled with administrative and educational achievements, qualifies Edward Lull Cochrane for honorary membership in the ASME. Retired from the U. S. Navy in 1947, he was for five years head of the Department of Naval Architecture and Marine Engineering at the Massachusetts Institute of Technology and subsequently has served as dean of engineering there.

Admiral Cochrane, born at Mare Island, Calif., in 1892, studied at the University of Pennsylvania for a year before entering the U. S. Naval Academy. He was graduated with distinction in 1914 and was assigned to sea duty for the next two years. He then went to M.I.T. for postgraduate work, which was interrupted by active duty at the Philadelphia Navy Yard in 1917–1918. After he obtained his MS degree in 1920, assignments at the Philadelphia and Portsmouth Yards, with the Scouting Force of the Fleet, and in the Bureaus of Construction and Repair and of Ships, made use of his exceptional ability in the design and construction of naval vessels. He was made a rear admiral in 1942, when he was appointed chief of the Bureau of Ships, and vice-admiral three years later. In 1946–1947 he was chief of the Material Division, Office of the Secretary of the Navy.

Special assignments included that of assistant naval attaché at London, 1940–1941, and membership on President Truman's Advisory Commission on Merchant Marine, 1947. In 1950–1952, on leave from M.I.T., he was chairman of the Federal Maritime Board and maritime administrator in the Department of Commerce.

Awards to Admiral Cochrane include the Mexican Campaign Medal, 1915; Victory Medals of World Wars I and II; David W. Taylor Medal, 1945; and the Navy's Distinguished Service Medal, 1946, when he was also made an honorary Knight Commander, Order of the British Empire. His honorary degrees are LLD, Hahnemann Medical College; DE, Polytechnic Institute of Brooklyn; and DS, Tufts College. He is a past-president of the Society of Naval Architects and Marine Engineers and a member of a number of engineering societies here and in Great Britain.

WILLIAM A. HANLEY

Honorary membership in the ASME is given to William Andrew Hanley upon the fortieth anniversary of his affiliation with the Society. It follows his election as a Fellow in 1936 and as president in 1940, subsequent to his having held the offices of manager and vice-president. He has also rendered notable service in section and committee activities for many years.

Dr. Hanley was born in Greencastle, Ind., in 1886. He was graduated from St. Joseph's College, Rensselaer, Ind., in 1902 and took further work there in 1907–1908. Purdue University gave him a BS degree in mechanical engineering in 1911 and an honorary DE degree in 1937.

From 1902 to 1907 Dr. Hanley was employed in Muncie, Ind., by the Republic Iron & Steel Company and the Broderick Boiler Company. In 1911 he began his long association with Eli Lilly & Company, Indianapolis, Ind. He soon became its chief engineer and master mechanic and then director of all engineering. He was made a partner in the firm in 1913 and for many years was its vice-president; he retired at the end of 1951. He has been a director since 1938 and is also a director of the Indianapolis Power and Light and Water companies. During the years 1942–1945 he was civilian aide to the U. S. Army Air Forces and the Office of Naval Procurement.

Dr. Hanley has contributed some 50 papers on engineering and economic subjects to the press. He is a Fellow of the American Association for the Advancement of Science, past-president of the Indiana Engineering Society, and an honorary member of Tau Beta Pi and Pi Tau Sigma.

He served as president of the Board of Directors of the City-County Building Authority, Indianapolis and Marion County; as director of housing and hospital-development groups in Indianapolis, and of the Chamber of Commerce there; and director, 1947–1953, of the U. S. Chamber of Commerce. He is president of the Purdue Board of Trustees and is also a trustee of St. Joseph's.

Dr. Hanley has recently been elected to the Board of Directors of the Federal Reserve Bank of Chicago, Ill.

ALEXANDER C. MONTEITH

Not only for his own achievements in engineering, management, and education, but also for those which his leadership inspires does the ASME confer honorary membership on Alexander Crawford Monteith, a member of the Society since 1943.

Born in Canada in 1902, he was graduated from Queen's University, Kingston, in 1923, with a BS degree in electrical engineering, and went to the Westinghouse Electric Corporation at Pittsburgh, Pa., as a student engineer. He was assigned to the central-station engineering department in 1924 and became its manager in 1938. In 1941 he was named manager of the industry engineering department and four years later took over the dual position of manager of headquarters engineering departments and director of education. He was elected to his present position of vice-president in charge of engineering in 1948. The Westinghouse Order of Merit was awarded him in 1940, and an honorary LLD degree by Queen's University in 1948.

Made Honorary Members of the ASME

EDWARD L. COCHRANE
Honorary Membership

WILLIAM A. HANLEY
Honorary Membership

ALEXANDER C. MONTEITH
Honorary Membership

SHEPPARD T. POWELL
Honorary Membership

WILLIAM F. RYAN
Honorary Membership

Dr. Monteith has many inventions for electrical apparatus and power systems to his credit. He is coauthor of the "Electrical Transmission and Distribution Reference Book," widely used in the power industry and colleges of America, and author of numerous papers on power-system problems and, more recently, articles on human relationships of management, industry, and engineers.

He gave outstanding service to the engineering profession when through his leadership as chairman of the ECPD Committee on Training the postcollege development program was made specific and put into action.

He also rendered notable public service on the Scientific Advisory Committee on Specialized Personnel for National Selective Service and on the Engineering Manpower Commission of the Engineers Joint Council.

Dr. Monteith is a Fellow of the American Institute of Electrical Engineers, has served as director for four years and as a member of three important policy-forming committees. He has also provided leadership in other committee work, including power generation, education, and standardization.

He is a member of the American Society for Engineering Education, Engineers' Society of Western Pennsylvania, and Tau Beta Pi.

SHEPPARD T. POWELL

Sheppard Tappen Powell, consulting engineer of Baltimore, Md., now elected to honorary membership in the ASME, is recognized internationally as an authority on the treatment of water for sanitary and industrial purposes and the design of industrial-waste facilities. He is possibly best known in connection with conditioning water for high-pressure boilers and for his scientific approach to allied problems in power generation.

Born in Troy, N. Y., in 1883, Mr. Powell took the famous water-purification course under William Pitt Mason at Rensselaer Polytechnic Institute. After two years as chief chemist at the James M. Caird Laboratories in Troy, he was chief chemical engineer for the Baltimore County Water & Electric Company until 1921. His connections as a consultant include the Consolidated Gas, Electric Light & Power Company since 1917; Stone & Webster Engineering Corporation since 1927; the City of Baltimore and the Maryland Department of Health during the 1920's; the National Resources Board since 1937; and since the early 1940's the Tennessee Valley Authority, Bureau of Yards and Docks, and Reconstruction Finance Corporation.

He was a special lecturer at The Johns Hopkins University, 1927–1937, on sanitary engineering and its application in various countries. Two noteworthy symposiums (1947 and 1953) on industrial wastes were prepared under Mr. Powell's guidance for the American Chemical Society. In 1934 he was the Marburg Lecturer of the American Society for Testing Materials.

As chairman of the Boiler Feedwater Studies Committee durings its first ten years and since then as a member of its executive committee, Mr. Powell has helped to guide its extensive research. A member of the ASME since 1939, Mr. Powell became a Fellow in 1944. He has been a member of the Engineers Joint Council Water Policy Task Group since 1950.

His many papers and lectures and his books on "Boiler Feed-Water Purification" and "Conditioning of Water for Industrial Uses" are significant contributions to the advancement of the art of water treatment.

WILLIAM F. RYAN

Born in Woodbury, Conn., in 1889, William Francis Ryan received his BA from Harvard College in 1911 and an MME from the Harvard Engineering School in 1913. His first employment was with the Interborough Rapid Transit Company, New York, N. Y., where by 1917 he had become construction superintendent for a large installation at the Fifty-Ninth Street Station. During World War I he operated power plants of the Wright-Martin Aircraft Corporation, after which he joined the Harry M. Hope Engineering Company of Boston, serving first as an operator and later as a designer of steam-power stations. For five years he was employed by subsidiaries of the Allied Chemical & Dye Corporation, and he designed and placed in operation the first high-pressure (750 psi) industrial power plant at Syracuse, N. Y. He was also mechanical engineer for the design of the great nitrogen fixation plant at Hopewell, Va.

Transferring to Stone & Webster Engineering Corporation, Boston, Mass., in 1929, he was first, mechanical engineer, then advanced through positions of increasing importance to become vice-president.

Mr. Ryan is the author of a number of technical papers and coauthor of a radio script broadcast in a weekly series over Station WEEI, Boston, to interest boys of high school age in seeking an engineering education. He is the inventor of the dual-circulation boiler now being used by public utilities to reduce carryover of impurities in steam.

Honorary membership in the ASME comes to Mr. Ryan after an affiliation with the Society dating from junior membership in 1917. He became a member in 1924 and a Fellow in 1938. He has served on local committees in Syracuse, N. Y., and Boston, Mass., and as chairman of the Power Division and the Publications and Professional Conduct committees. He has represented the Society in standardization, professional development, and other joint activities. He is a past-president of the Massachusetts Society of Professional Engineers, past vice-president of the National Society of Professional Engineers, and belongs to the Boston Society of Civil Engineers and the American Society for Engineering Education.

Recipients of Medals and Awards

ASME MEDAL, 1953

CROSBY FIELD. The ASME Medal is awarded to Crosby Field, distinguished engineer, inventor, and manufacturer, who through his high engineering skills and inventions has established and expanded industries and made invaluable contributions to improved designs and production techniques in many fields.

Born in Jamestown, N. Y., in 1889, he received a BS degree from New York University in 1909 and an ME from Cornell University in 1912. In 1914, during his "internship" with the General Electric Company at Schenectady, N. Y., he received an MS EE from Union College.

Colonel Field has pioneered in several industries, to which he not only contributed inventions and other improvements in processes, methods, equipment, and plants, but in which he also built organizations and managed them. More than a hundred U. S. patents issued to him include those for machinery for the manufacture of steel and other metal wool; and a method of making small ice which led to the formation of the Flakice Corporation, of Brooklyn, N. Y., of which he is president.

He has been employed by both large and small organizations. To the latter he has given major attention because of his belief that the percentage of small manufacturing and other businesses must remain large if our American form of society is to continue.

He was in active service in Army Ordnance during both world wars, attaining the rank of colonel. His application of engineering analysis was a major factor in reducing life hazard in the tremendous explosive industry during World War II. He was awarded the Legion of Merit in 1946.

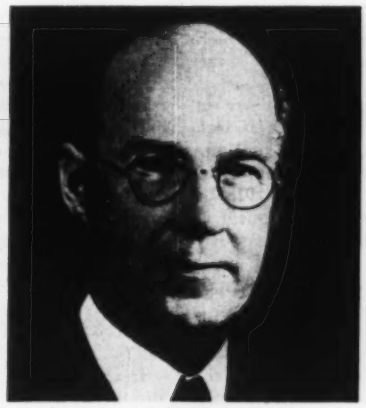
Affiliated with the ASME since 1915, he was elected a Fellow in 1938. He is also a Fellow of the American Institute of Electrical Engineers, a past-president of the American Society of Refrigerating Engineers, and a member of a number of other engineering societies and fraternal bodies. Through committee service and numerous papers and addresses he has shared his professional and administrative experience with others.

ASME WESTINGHOUSE AWARD

The ASME George Westinghouse Gold Medal Award, established in 1953 by a gift from the Westinghouse Educational Fund, is bestowed for eminent achievement or distinguished service in the power field of mechanical engineering.

ALEXANDER G. CHRISTIE. The first ASME Westinghouse Award goes to Alexander Graham Christie, who as educator, consultant, writer, and participant in city, state, federal, and

CROSBY FIELD
ASME Medal



ALEXANDER G. CHRISTIE
ASME Westinghouse Award

PHILIP M. MCKENNA
Holley Medal

WILLIAM H. MCADAMS
Worcester Reed Warner Medal

JEFFERSON C. FALKNER
Melville Medal

technical-society activities, has influenced the design and construction of power projects in many parts of the world.

Born in 1880 in Manchester, Ont., Can., Dr. Christie came to the United States in 1901, after graduation from the University of Toronto. He helped develop and construct steam turbines and gas engines at the Westinghouse Machine Company; taught at Cornell University; directed the erection, test, and operation of the first steam turbine built by the Allis-Chalmers Manufacturing Company; and built and operated a Canadian power plant.

This experience led in 1909 to an assistant professorship in steam and gas engineering at the University of Wisconsin, where he later became an associate professor. He received an ME degree from the University of Toronto in 1913 and the following year joined the faculty of The Johns Hopkins University, reaching a full professorship in 1920. For many years he was in charge of the evening engineering and technological school. In 1952 the University conferred the LLD degree upon him and appointed him emeritus professor of mechanical engineering.

Dr. Christie has also received the DE degree from Stevens Institute of Technology and Lehigh University. The Lamme Medal of the American Society for Engineering Education was awarded him in 1948. In recognition of his work as a member of the Engineering Education Mission to Japan in 1951 he was elected an honorary member of the Society of Mechanical Engineers (Japan).

Dr. Christie has held membership in the ASME since 1907, became a Fellow in 1936, was president in 1938–1939, and was elected an honorary member in 1946. To the work of the Power Test Codes Committee in particular he has devoted himself for many years.

HOLLEY MEDAL

PHILIP M. MCKENNA. The award of the Holley Medal to Philip Mowry McKenna recognizes not only his long research culminating in the discovery in 1937 of a new intermetallic compound, tungsten titantium carbide, but also the importance of the invention's application in the machine-tool and mining industries.

Born in Pittsburgh, Pa., in 1897, the son of Alexander G. McKenna, a well-known metallurgist, his early work was as a chemist with the U. S. Bureau of Standards and with the

Chemical Products Company, Washington, D. C. He became general manager and vice-president of this company, which produced tungsten from a low-grade ore by a process he invented.

After graduation from George Washington University in 1921 with an BA degree, Mr. McKenna engaged in research looking toward the development of the best possible tool material. Becoming research director and vice-president of his father's company, Vanadium Alloys Steel Company, in 1928, he carried on the experiments which resulted in the cemented-carbide composition far superior to the tool materials previously used to cut steel.

Early in 1938 Mr. McKenna founded the McKenna Metals Company, Latrobe, Pa., which later became Kennametal, Inc., of which he has been president and director since 1943. He is also president and director of Kennametal of Canada, Ltd. The facilities of these companies are devoted solely to the processing, manufacture, and application of cemented-carbide products widely used in metalworking plants.

Mr. McKenna, a member of the ASME since 1941, is a Fellow of the American Association for the Advancement of Science and a member of the American Institute of Mining and Metallurgical Engineers, American Chemical Society, and American Society of Tool Engineers. He has contributed numerous papers to the technical press and engineering societies.

WORCESTER REED WARNER MEDAL

WILLIAM H. MCADAMS. A list of publications by William Henry McAdams, compiled in 1952, contains 58 items, dating back to 1920. Of all these papers and books of which he was author or coauthor, the one regarded as particularly meriting the Warner Medal is his book, "Heat Transmission." The critical evaluation and correlation data presented therein makes it a standard reference book.

Dr. McAdams was born in 1892 in Cynthiana, Ky. He attended Transylvania University for two years and received the degrees of BS and MS at the University of Kentucky in 1913 and 1914 and the honorary degree of DS there in 1945. He joined the faculty of the Massachusetts Institute of Technology in 1914 as an assistant in analytical chemistry. He has continued to serve the Institute except for a short period in 1914–1915 with the Goodyear Tire & Rubber Company and service in the two world wars.

In 1918–1919 he was first lieutenant in the Chemical Service Section and captain in the Chemical Warfare Service. During World War II he was chairman of the Subcommittee on Heat Exchangers of the National Advisory Committee for Aeronautics. His work on two NACA heat-transfer projects, together with projects for the National Defense Research Committee, brought him the President's Certificate of Merit in 1948. In that year he also received the Walker Award of the American Institute of Chemical Engineers.

He was awarded the master of science degree by M.I.T. in 1917. He rose to a full professorship in chemical engineering in 1927, and from 1947 to 1949 he served as chairman of the faculty. Since 1925 he has also been a lecturer on the faculty of Harvard University.

A member of the ASME since 1947, he also belongs to the American Chemical Society, American Institute of Chemical Engineers, American Society for Engineering Education, and other professional groups.

MELVILLE PRIZE MEDAL FOR ORIGINAL WORK

JEFFERSON C. FALKNER. In the November, 1953, issue of the Transactions of the ASME will be found the paper on "Quick-Starting of Large High-Pressure High-Temperature Boilers," which won the Melville Medal for Jefferson Cameron Falkner. This paper was presented at the 1952 Annual Meeting and is one of several reporting on research initiated by him which has resulted in methods for substantially reducing the starting time of high-temperature high-pressure turbines and boilers after shutdowns.

Born in Montgomery, Ala., in 1889, Mr. Falkner secured his early education there and was graduated from the Alabama Polytechnic Institute in 1910 with a BS degree in electrical engineering. He then took the test course of the General Electric Company in Schenectady, N. Y., and remained with the company until 1913. After a year's work for the Alabama Power Company he became chief operating engineer of the Richmond Light & Railroad Company, New Brighton, Staten Island, N. Y.

In the spring of 1920 Mr. Falkner entered the employ of the Brooklyn Edison Company, having charge of installing mechanical equipment in the Hudson Avenue Generating Station and serving as the station's first superintendent of operation.

In 1926 he became assistant research engineer of the New York Edison Company, and when it and the United Electric Light & Power Company were merged in 1933, he was appointed assistant chief operating engineer. He was assistant operating superintendent of Brooklyn Edison, 1936–1937, and since its merger with New York Edison he has been manager of the electric production department of the Consolidated Edison Company.

Mr. Falkner has belonged to the ASME since 1923 and was elected a Fellow in 1951.

PI TAU SIGMA RICHARDS MEMORIAL AWARD

THOMAS M. LUMLY. Graduated in 1931 from Oklahoma A&M College with a BSME degree, Thomas Melvin Lumly began work with the Shell Pipe Line Company in East Texas, soon becoming assistant chief engineer of the Texas and New Mexico Pipe Line Division. Further experience in petroleum-refinery construction and operation was obtained during 1933–1936 with the Kanotex Refining Company, of Arkansas City, Kan. Then came three years in similar work for the Cushing (Okla.) Refinery & Gas Company and two years for the Cosden Petroleum Corporation, Big Springs, Texas.

In 1938 Mr. Lumly organized the Motor Fuels Corporation to build an oil refinery near Levelland, Texas, and a pipe line to the newly discovered Slaughter field. He sold his interest to become general manager of the National Oil Proprietary Limited, of Sydney, an Australian government war agency. His successful operation of a shale-oil refinery and the construction of a forty-mile pipe line, involving training of personnel and other problems, won him citations from the government.

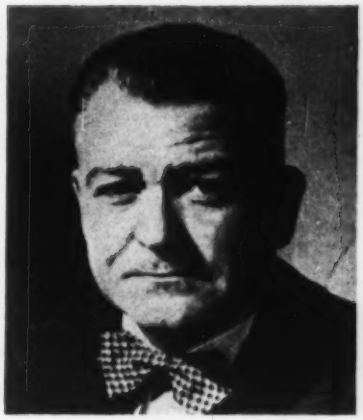
After the United States entered the war, Mr. Lumly returned and organized the Refinery Engineering Company, Tulsa, Okla., devoted during the war to building critical war plants and equipment and to the fabrication of invasion barges for the Navy. Since the war the company has expanded into five corporations operating in the United States and Canada.

He has found time also for chemical and mechanical research, holds patents in both fields, and has contributed articles to trade journals.

He is a member of the ASME, the American Association for the Advancement of Science, and various civic and professional groups in Tulsa. He is a native of Oklahoma, born at Wetumka in 1907.

THOMAS M. LUMLY
Pi Tau Sigma Richards Memorial Award

MERL BAKER
Pi Tau Sigma Gold Medal Award



THOMAS E. MILLSOP
Gantt Medal

PI TAU SIGMA GOLD MEDAL AWARD

MERL BAKER. It is only eight years since Merl Baker received his BSME degree at the University of Kentucky. His naval service, educational accomplishments, publications, and activity in professional organizations have made these years unusually fruitful ones, meriting recognition by the Pi Tau Sigma Gold Medal Award.

A Kentuckian by birth (Cadiz, 1924), Dr. Baker secured his early education and engaged in construction work in that state prior to entering college. He was active in student affairs at the University, being a member of the ASME Student Branch and managing editor of *The Kentucky Engineer*, among other activities.

Following his graduation he served for about a year in the U. S. Navy, then went to Purdue University where he was part-time instructor, 1946–1948, while earning his MSME degree. He returned to the University of Kentucky in 1948 as assistant professor of mechanical engineering and was advanced to associate professor in 1952. He has recently been appointed director of the University's Research Foundation. The PhD degree was conferred upon him by Purdue University in 1952.

Dr. Baker's particular field is that of heating and ventilating engineering, and a number of his papers on this subject have appeared in Bulletins of the University of Kentucky Engineering Experiment Station and in *Heating, Piping and Air Conditioning*. His professional and fraternal memberships include the American Society of Heating and Ventilating Engineers, American Society for Engineering Education, Kentucky Academy of Science, Sigma Xi, and Pi Tau Sigma.

GANTT MEDAL AWARD FOR 1953

THOMAS E. MILLSOP. A life "dedicated to selfless service" in four categories—industrialist, educator, humanist, and public servant—has won the Gantt Medal for Thomas E. Millsop. Born in 1898 at Sharon, Pa., and educated in the public schools there, he enlisted and served in the U. S. Marine Corps, 1917–1919, and then began work with the Standard Tank Car Company in Sharon as a riveter. Except for a year, when he engaged in scrap business with the Rotter-Spear Company of Cleveland, Ohio, he remained with Standard Tank until 1927, becoming its production manager. He then entered the employ of the Weirton (W. Va.) Steel Company as a salesman and by 1936 he had become its president. He is also a vice-president of the National Steel Corporation, of which the Weirton Steel Company is a division, and president of several other national subsidiaries.

As an industrialist Dr. Millsop has instituted policies of great benefit to the company's employees and their families. In 1949 the National Council on Rehabilitation conferred an Award of Merit upon him "for his deep interest in rehabilitation . . . who by providing jobs to the disabled makes it possible for the handicapped to illustrate their capacity for collective and individual contributions to our nation." Over a thousand wounded veterans of World War II were returned to their regular Weirton jobs, irrespective of the extent of their disabilities. The prevention of accidents at Weirton has also been one of Dr. Millsop's concerns, and under his administration disabling work accidents have steadily been reduced.

His interest in eduction is reflected in his membership on the Board of Governors of the West Virginia University since 1948 and on the Board of Advisors of the College of Steubenville since 1950. He holds three honorary degrees: LLD, from Bethany College, 1943; Doctor of Humanities from Wilberforce University, 1952, and from Marietta College, 1953. He is one of seven men who received the 1952 Horatio Alger Award from the American Schools and Colleges Association.

In April, 1947, when four communities consolidated to form the present Weirton, Dr. Millsop was urged to become a candidate for mayor. Although he made no campaign—at the time of the primaries he was, in fact, with a group whose personnel was made up of heads of major industries sent to Germany and Austria on a special mission for the War Department—he was nominated, and he was elected by a five-to-one majority. He was re-elected in June, 1951, for a second four-year term. Among the civic projects organized and carried to fruition under his guidance were a million-dollar community-center building and city recreation program, a three-million-dollar general hospital, the extension of a city water supply and sewer system to the entire community, and the improvement of streets and sidewalks and extension of the street-lighting system.

Dr. Millsop served as director of the Federal Reserve Bank,

PETER ASHURKOFF
Charles T. Main Award

GEORGE LEPPERT
Postgraduate Student Award

ROBERT M. BELL
Undergraduate Student Award

Fourth District, Cleveland, Ohio, from 1940 to 1947, and is a director of the Bank of Weirton and The People's Bank, Weirton. He is a member of the American Iron and Steel Institute and of the Iron and Steel Institute (London).

The Gantt Medal was presented to Dr. Millsop at the Honors Luncheon, Wednesday, December 2.

CHARLES T. MAIN AWARD

PETER ASHURKOFF was born in Mexico City, Mexico, on July 4, 1932. He lived in various parts of Mexico until the fall of 1945, at which time he went to preparatory school at the Phillips Exeter Academy, Exeter, N. H. After graduating from Exeter in June, 1949, he entered Princeton University, where he received his BS degree in mechanical engineering in June, 1953. At present he is working for an MS degree in mechanical engineering at the Massachusetts Institute of Technology. He expects to complete the course in June, 1954.

The subject of the paper for which Mr. Ashurkoff has won the Charles T. Main Award is "The Engineer's Contribution to the Increase in the Standard of Living."

Mr. Ashurkoff was a student member of the ASME while he was studying at Princeton University, and he has joined the Branch at the Massachusetts Institute of Technology.

The Charles T. Main Award was presented at the Members and Students Luncheon, Thursday, December 3.

POSTGRADUATE STUDENT AWARD

GEORGE LEPPERT, winner of the Postgraduate Award for his paper, "A Stable Numerical Solution for Transient Heat Flow," was born in 1924 in Kansas City, Mo. He received the degree of bachelor of science in mechanical engineering from the University of Wisconsin in 1947 and that of master of science in the same field from the Illinois Institute of Technology in 1952.

During the academic year 1952–1953 he was the holder of a National Science Foundation predoctoral fellowship, and he expects to receive the PhD degree from the Illinois Institute of Technology in February, 1954.

Mr. Leppert had nearly three years of naval service during World War II, being assigned, after his training, to the post of submarine officer for the operation and repair of submarines. From 1947 to 1949 he was employed by the Monsanto Chemical Company, St. Louis, Mo., as maintenance and construction engineer. He was instructor in mechanical engineering at Washington University, teaching thermodynamics and heat power, during the year 1949–1950. The Argonne National Laboratory at Lemont, Ill., engaged him as a mechanical engineer from 1950 to 1952 and for a brief period in 1953. He then rejoined the Monsanto Chemical Company in his present capacity of manager of the Engineering Research Section of their general engineering department at Dayton, Ohio.

Mr. Leppert belonged to the Student Branches of the ASME at the University of Wisconsin and Illinois Institute of Technology. He is now associate member of the Society.

The Postgraduate Student Award was presented at the Members and Students Luncheon, Thursday, December 3.

UNDERGRADUATE STUDENT AWARD

ROBERT M. BELL. The recipient of the Undergraduate Student Award is Robert McGillivray Bell. His paper is entitled "The Sixty-Inch Vertical Boring and Turning Mill Manufactured by the John Bertram & Sons Co., Ltd."

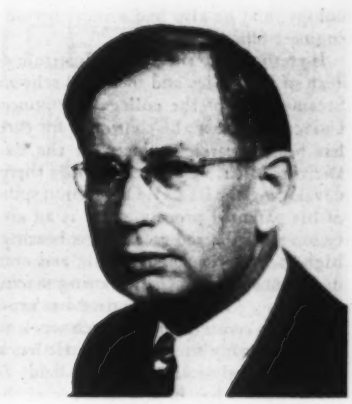
Mr. Bell was born in Ottawa, Ont., Can., on Feb. 24, 1930, and attended Ottawa public schools and the Glebe Collegiate Institute, from which he was graduated in 1949 with Senior Matriculation. He spent the first two years of his college course at Carleton College, in Ottawa, receiving a Diploma in Engineering in 1951. He then entered Queen's University, Kingston, Ont., where he received a BS degree in mechanical engineering in May, 1953. He was a student member of ASME at the University and secretary of the Branch during his final year there.

During the summer following his third year in college, Mr. Bell worked as a machine-tool fitter for the John Bertram & Sons Company, Ltd., of Dundas, Ont. Following graduation he was designer and draftsman for the Ives Bedding Company, Ltd., of Cornwall, Ont., until October, when he went to England to work as draftsman for Craven Bros. (Manchester), Ltd., Reddish, Stockport, Cheshire, in order to further his studies in the design of machine tools.

The Undergraduate Student Award was presented at the Members and Students Luncheon, Thursday, December 3.

ERNEST WILDHABER
Machine-Tool Award

ROBERT R. SLAYMAKER
Machine-Tool Award



CARROLL R. ALDEN
Machine-Tool Award

MACHINE-TOOL DESIGN AND ECONOMIC-VALUE AWARDS

The Machine-Tool Design and Economic-Value Awards, made available in 1953 by the National Machine Tool Builders' Association, are presented for the best three original papers submitted by members of the ASME on the general subject of machine-tool design and economic value.

ERNEST WILDHABER. The inventor of the hypoid gears and many other devices, Ernest Wildhaber, has won the first of the Machine-Tool Awards. His paper is titled "Manufacture and Application of Gleason Toothed Face Couplings and Clutches." He is a mechanical engineer in Rochester, N. Y.

Mr. Wildhaber came to the United States from Switzerland. He was born in Lucerne in 1892 and secured his ME degree at the Federal Polytechnic Institute in Zurich in 1916. During the next three years he was employed in his native country, in 1918–1919 in charge of patents for the Maag Gear Company in Zurich.

His first connection here was with SKF Industries in New York, N. Y., but in 1920 he went with Niles Bement-Pond, New York, N. Y. In 1924, after engaging in independent inventive and consulting work for a year, he took a position as mechanical engineer at the Gleason Works, where he has continued until recently, except for 1927–1931, when he gave full time to his inventions.

His hypoid gears have found wide application as the final drive in rear axles of passenger cars and trucks. His other numerous inventions include methods of generating these gears; various methods of generating spiral bevel gears in quantity; the Gleason system for generating spiral bevel gears in jobbing lots; the Gleason 1940 generating grinder with its continuously rotating work and its novel cam control; the Revacycle method of cutting straight bevel gears in record time with a large disk cutter completing a tooth space in each turn; and the Curvic face couplings and Curvic face clutches and the methods of producing their teeth.

A number of articles relating to his inventions have appeared in the technical press. In 1951 he was elected a Fellow of the ASME, which he joined in 1923.

ROBERT R. SLAYMAKER. The winner of the second Machine-Tool Award is Robert Ridgley Slaymaker, professor of machine design at the Case Institute of Technology. His paper deals with "Bearing Design Using Concentric Journal Theory." It is one of a number of his contributions to the technical press.

Professor Slaymaker is a native of Wheeling, W. Va., where he was born in 1904, but his college-preparatory education was obtained in Lincoln, Neb., and he was graduated from the University of Nebraska in 1925 with a BS degree in mechanical engineering. He received an MS from Iowa State College in 1932.

His industrial experience began in 1925 with the Dravo Contracting Company of Pittsburgh, Pa., to which he returned in 1927, after a year of teaching at the University of Arkansas. He worked for the Jones & Laughlin Steel Corporation during the summer of 1928, before going to Dallas, Texas, to accept an assistant professorship in mechanical engineering at Southern Methodist University. He was associate professor, 1931–1936, and professor and head of the department during his last year there, 1936–1937. While in Dallas he also was engineer in charge of production for Sutton, Steele & Steele, Inc., 1932–1935.

At the Case School of Applied Science, as it was called when he joined the faculty, he not only taught machine design, but also served as dean of the Junior Division and acting head of the department of engineering administration. Shortly before World War II he did consulting work for several firms, including the Cleveland Graphite Bronze Company, and during the war he served as its training director. He then resumed his duties at Case, continuing as consultant for the company.

Professor Slaymaker joined the ASME in 1926 and has held the grade of member since 1935. He also belongs to the American Society for Engineering Education, Cleveland Engineering Society, and Sigma Xi and Sigma Tau fraternities.

CARROLL R. ALDEN. His paper on "Electrospark Machining," published in the September, 1953, issue of MECHANICAL ENGINEERING, brings the third of the Machine-Tool Awards to Carroll Russell Alden.

Mr. Alden was born in Ohio in 1889 and attended high school in Marietta. He received degrees in electrical and mechanical engineering at Ohio Northern University in 1915 and 1916 and an MS degree from the Detroit Institute of Technology, where he taught prior to entering active naval service in 1918.

As a junior lieutenant he was instructor at the United States Navy School of Steam Engineering at Stevens Institute of Tech-

nology, and he also had a short period of sea duty as assistant engineer officer.

He returned to the Detroit Institute of Technology in 1919 as dean of the trades and technical schools. Three years later he became dean of the college of engineering at Ohio Northern University, where he continued for three years. Since 1923 he has been research engineer for the Ex-Cell-O Corporation, of Detroit, Mich. In his early years there he was instrumental in developing the Ex-Cell-O precision spindle, on which, by means of his patented process, there is an area of perfect contact between the balls and races in the bearings. He also developed a high-speed air-turbine spindle and contributed greatly to the development of precision boring machines and their hydraulic controls. As the organization has grown, his interests have remained in creative and research work and the patent protection of the company's many lines. He has been a frequent contributor to the technical press in his field.

Mr. Alden has been a member of the ASME since 1927 and also belongs to the Society of Automotive Engineers. He has been active in the local section work of both societies in Detroit.

The three Machine-Tool Awards were presented at the Honors Luncheon, Wednesday, December 2.

ASME LECTURERS, 1952–1953

The ASME Lectures were instituted to bring to Sections of the Society, on a biennial basis, outstanding speakers on subjects of broad general interest and value to members of the profession of mechanical engineering. During the several years that the Lectures have been established, a number of leading engineers have been selected for this service. The selection is, in itself, an honor. The Lecturer donates his time and receive no honorarium.

EARLE BUCKINGHAM, Fellow ASME, professor emeritus, mechanical-engineering department, Massachusetts Institute of Technology, Cambridge, Mass., "Dimensions and Tolerances for Mass Production."

JACOB P. DEN HARTOG, Fellow ASME, professor of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass., "Vibration."

CLAYTON O. DOHRENWEND, Mem. ASME, research engineer, department of mechanics, Rensselaer Polytechnic Institute, Troy, N. Y., "One-Hundred Years of Scientific Achievement in Mechanics of Solids."

CHARLES LIPSON, Mem. ASME, consultant, Detroit, Mich., "Stress and Vibrations Problems in Industry."

GLENN MURPHY, Mem. ASME, head, department of aeronaucal engineering, Iowa State College, Ames, Iowa, "Problems of Nuclear-Power Development."

JESSE ORMONDROYD, Mem. ASME, professor, college of engineering, University of Michigan, Ann Arbor, Mich., "Vibration-Measuring Instruments."

IRWIN VIGNESS, head, Shock and Vibration Branch, Naval Research Laboratory, Washington, D. C., "Problems of Mechanical Shock and Vibration of Concern to the Armed Services."

. Certificates were presented at the President's Luncheon, Monday, November 30.

ATTENDING THE ANNUAL BANQUET

(*Left to right* are Lewis K. Sillcox, the incoming President; William A. Hanley, William F. Ryan, Edward L. Cochrane, Sheppard T. Powell, and A. C. Monteith—the new Honorary Members of ASME; and F. S. Blackall, jr., President.)

1953 ASME ANNUAL MEETING

Week of Nov. 29–Dec. 4, 1953, Crowded With Technical Sessions, Social Events, and Discussions of Society Affairs

SO large has the attendance at Annual Meetings of The American Society of Mechanical Engineers grown and so extensive and varied have programs of technical sessions become that the 1953 Meeting, held in New York, November 29–December 4, taxed the capacity of three hotels—the Statler, McAlpin, and Governor Clinton. The attendance, 8000 members and guests, exceeded all previous records, as did the number of technical sessions (in excess of 100), and the number of papers (more than 300), 80 per cent of which were in preprint form. The program of 168 pages listed the names of approximately 500 authors and speakers.

Committee meetings, public luncheons and dinners, the President's address, the Wright and the Towne Lectures, inspection trips, a full calendar of social and other events for the women in attendance, and the co-operation in the meeting of the American Rocket Society, affiliated with ASME, and the Society for Experimental Stress Analysis, all combined to make the busy week a fruitful and memorable experience for everyone in attendance.

In addition to the usual honors conferred at ASME Annual Meetings, two new awards were inaugurated; the Machine-Tool Design and Economic Value Awards (three in number), established by the National Machine Tool Builders Association, and the Westinghouse Medal, established by the Westinghouse Educational Fund. In appropriate commemoration of the first powered flight by the Wright Brothers fifty years ago, the Aviation Luncheon was addressed by Igor I. Sikorsky on the engineer's contribution to powered flight and a scroll was presented to Dr. W. F. Durand, past-president and Honorary Member of ASME, pioneer in the science of aeronautics, "for his great contribution to the field of Aviation."

MEETINGS OF THE COUNCIL

As is customary, the Council met for luncheon on Sunday and began its deliberations immediately thereafter, continuing on Monday, with a dinner on Monday evening and a session for the orientation of new Council members on Tuesday morning. On Sunday evening members of the Council met with members of ASME Boards, Divisions, and Committees in a joint conference at which discussion centered around the plans of the Board on Technology for the improvement of meetings and publications and the proposal of the Organization Committee on a reorganization of the Council. A brief report of this conference will be found on pages 73–77.

The actions taken at the business sessions of the Council will be found in greater detail on pages 125–127. Reports of the Council, Boards, Committees, joint activities, and of the Woman's Auxiliary were presented. The report of the Council and the financial report will be found in this issue, pages 54–63. Reports of the Boards, Committees, and joint activities are available on request. Five members of the staff were congratulated on periods of service with the Society of 25 years (in one case 35 years). Among the high lights of the Council's discussions, the problem of a new headquarters for the Founder Societies and a proposal for the reorganization of the Council were prominent. These subjects were also discussed at the Business Meeting and on other occasions (see pages 77–79). A report on the results to date of the recently inaugurated "free coupon" policy was received. Ratification was voted of an agreement, effective Jan. 1, 1954, between the American Institute of Electrical Engineers and The American Society of Mechanical Engineers (see page 126) under which "a member of one of the two Societies may become a member of the other without payment of initiation or entrance fee in the second Society," provided he presents his application for membership in the second Society and meets the membership requirements of the Second Society.

Actions on recommendations of the 1953 Regional Delegates Conference were approved.

MR. BLACKALL ADDRESSES THE SOCIETY

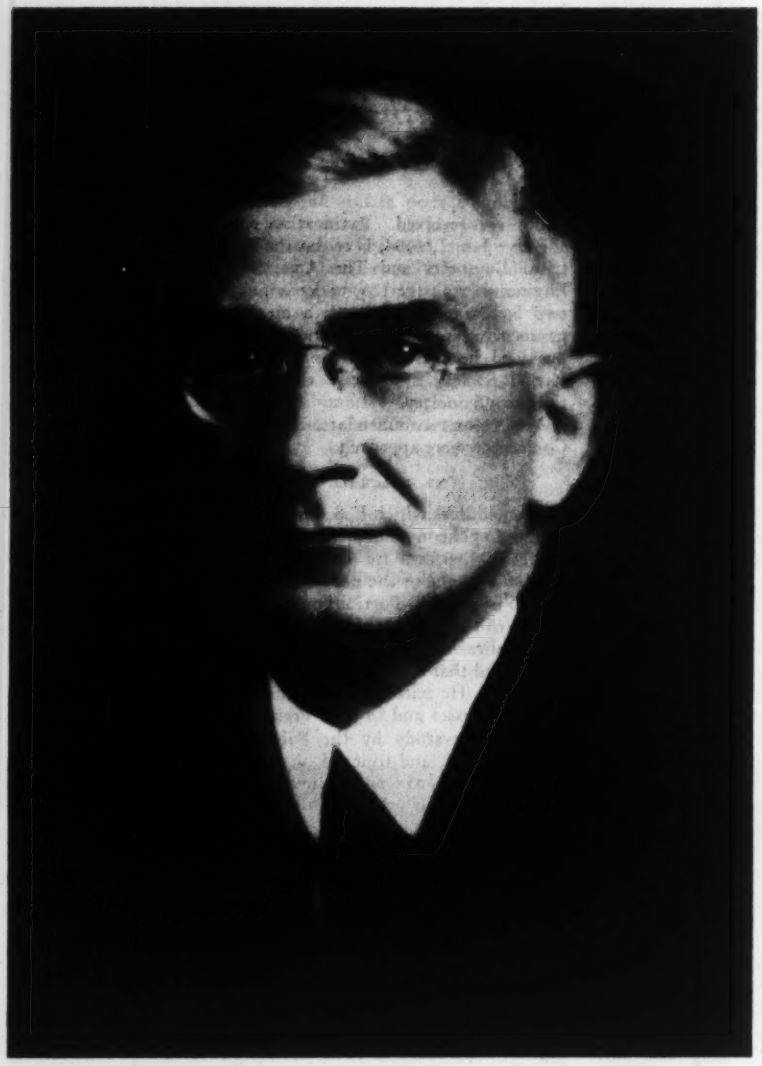
In an address which F. S. Blackall, jr., delivered at the President's Luncheon under the title, "Retrospection and Foresight—A Platform for Progress," the President directed attention to some of the needs of the Society which appeared to him to be urgent. Portions of his address will be found on pages 80–81, of this issue. Mr. Blackall turned his attention first to the publications, particularly MECHANICAL ENGINEERING, and announced that a new type face of larger size would soon be introduced. He reiterated views he had previously expressed in other addresses and in the "President's Page," which are currently under study by the Publications Committee and the editorial staff, and touched on the decision, taken during his administration, to send each member "free coupons" which may be exchanged for preprints of papers, and suggested some extensions of the policy. He made observations on the "need for a new approach to the nomination and election of the new members of Council and the officers of the Society" and reviewed the tentative suggestions of the Organization Committee in respect to these matters (see pages 74–76) including his personal views on certain features of the suggestions.

In respect to the Secretary's staff, Mr. Blackall made some constructive suggestions and announced the appointment of O. B. Schier to the post of assistant secretary. He devoted some time to a discussion of unity of the engineering profession, the growing need for close co-operation of engineering societies in the discussion of certain types of technical subjects, and the work of the Engineers Joint Council and the need of closer contact between that body and the members of the constituent engineering societies.

Mr. Blackall expressed his conviction in the need for a broader and more effective public-relations program for the Society. He reviewed the vexing problems confronting the Founder Societies in finding a headquarters building better-suited to their needs than the present Engineering Societies Building which has been outgrown and outmoded, and in the selection of a location for such an engineering headquarters. This subject was later discussed by him at the Business Meeting (see pages 77–79).

SUNDAY-NIGHT CONFERENCE

The Joint Conference of the Council with Professional Divisions, Boards, and Committees on Sunday evening, Nov. 29, 1953, was devoted to a discussion of the proposed reorganization of the Council and the policy to improve quality of meetings and publications.



Lewis K. Sillcox

President of
The American Society of Mechanical Engineers
for 1954

COUNCIL REORGANIZATION

F. S. Blackall, jr., president ASME, who presided, pointed out that on Oct. 6, 1953, the Executive Committee proposed that the Council make-up should be changed to include representation of the various activities in the Society and, in addition, place be made on the Council for men of broad experience.

The Organization Committee, he said, therefore recommended that the eight Directors be selected from leaders of, and considered as representatives of, activities as follows:

1 Four Activity Directors, serving four years, one selected each fourth year in order from the following activities into which the Professional Divisions and Research Committees might be grouped: (*a*) Basic Sciences, (*b*) Power Production, (*c*) Management and Production, (*d*) Industrial Applications.

2 Two Standardization Directors, serving four years, one selected every other year from those with experience and a record of leadership in ASME Standards and Codes work.

3 Two Directors at Large, serving four years, one to be selected every other year from those who have displayed leadership in the administrative work of the Society. Such committees as Finance, Organization, and Constitution and By-Laws, and the Boards on Honors, Membership, Education, and Public Affairs afford excellent training grounds for service on the Council.

Mr. Blackall stated further that the Organization Committee has reached the conclusion that in order properly to bring about the desired changes, the Nominating Committee must be increased. The present Nominating Committee, selected by the

New Members of the 1954 ASME Council

Regional Vice-Presidents

THOMPSON CHANDLER W. G. MCLEAN W. F. THOMPSON C. H. SHUMAKER V. A. PETERSON

Directors at Large

R. B. LEA F. L. BRADLEY

Regions and beholden to the geographical interests of the Regions, may not be well enough equipped with information and background on the important national activities of the Society to deal effectively with the selection of men in leadership in the national activities.

Accordingly the Committee recommends:

1 That the Nominating Committee be increased from eight to eleven, with alternates, the three additional members to be selected as follows—one by the Board on Technology, one by the Board on Codes and Standards, and one by the Council.

2 The Nominating Committee member selected by the Board on Technology would meet with representatives of the Professional Divisions and the Research Committees to select names of candidates for Activity Directors to be suggested to the Nominating Committee.

3 Every other year the Nominating Committee member selected by the Board on Codes and Standards would meet with representatives of the various standards and codes committees to select names of candidates for Standardization Directors to be suggested to the Nominating Committee.

4 Every other year the Nominating Committee member selected by the Council would scrutinize available leadership from the administrative committees to select names of candidates for Directors at Large to be suggested to the Nominating Committee.

The suggested procedures are exactly similar to those used in selecting Vice-Presidents. The By-Laws require the Nominating Committee member from each Region to meet with the officers of the Sections of the Region and secure suggestions as to candidates for the office of Vice-President of the Region.

To provide a place on the Council for men of outstanding professional leadership, the Organization Committee recommends that there be four administrative vice-presidents serving a term of two years, two elected each year, Mr. Blackall said.

The Committee also felt that in the light of the fact that under the proposed scheme the probability of having the presi-

ASME OFFICIALS AT THE ANNUAL BANQUET
(*Left to right*, Lewis K. Sillcox, new ASME President, C. E. Davies, Secretary of ASME, and F. S. Blackall, jr., outgoing President.)

dent selected from among those who had previously served on Council, it might be desirable for the number of past-presidents to be reduced from five to three, each serving three years after his term as president.

Briefly the proposed make-up of the Council as compared with the present would be as follows:

Present	*Proposed*
1 President	1 President
5 Past-Presidents	3 Past-Presidents
8 Vice-Presidents (Regional)	8 Vice-Presidents (Regional)
8 Directors	4 Activity Directors
–	2 Standardization Directors
22	2 Directors at Large
	4 Administrative Vice-Presidents
	–
	24

In the general discussion that followed, E. G. Bailey and T. F. Perkinson said that the plan is a step in the right direction. Specifically, Mr. Bailey said that the three-year term for past-presidents would result in a better changeover of personnel.

On the other side, H. H. Snelling felt that the present setup was doing a good job and he saw no need for a change. However, he did suggest that it might be better to choose four directors from the Professional Divisions and four directors from the Sections.

F. T. Hague also viewed the change with considerable apprehension. He indicated that he had his own proposal for a structure. He pointed out that the technical activities of the ASME are its lifeblood. Yet the Divisions are on their own and some even lack the support of ASME. He suggested that more assistance be given to the Professional Divisions—for example, better publicity for future technical meetings. He also called for men on the Council who knew the needs of the Divisions—Directors who can organize technical activities. Perhaps, he said, Directors should be chosen from Division chairmen. In summary, he said we should try to apply management principles to the technical side of ASME operation.

R. J. S. Pigott also concurred in the opinion that perhaps we do need better representation on the Council from the Professional Divisions. However, he said, don't underrate the members of the Council, because most have come up through the ranks and have been involved with Professional Divisions, technical committees, Sections, and the like.

In closing this portion of the discussion, President Blackall said that he would refer the proposal with appropriate comment back to the Council and the Nominating Committee. (For a report on actions of the Council, see page 126.)

IMPROVEMENT OF MEETINGS AND PUBLICATIONS

This second item for discussion was introduced by Joseph W. Barker who pointed out that the increase in the number of sessions at ASME National Meetings, particularly the Annual Meeting which has grown too large to be accommodated in a single hotel without extending into a second week, and a resulting increase in the number of papers recommended for publication in Transactions, coupled with a desire to render the best possible and most practicable service to members, led the Committee on Society Policy to suggest a review of Society meetings and publications by the Board on Technology. The Board appointed a Task Force Committee to conduct the review and to make recommendations to the Board.

The substance of the Board on Technology's recommendations are as follows:

1 The Meetings Committee shall, 12 months in advance, for each meeting, select a general theme, designate the number of sessions, and require each participating Division and committee to specify a general subject and a chairman for each technical session;

2 The Professional Divisions Committee shall require each

Division to hold an Annual Conference under its own sponsorship or in collaboration with other Divisions; and

3 The Publications Committee shall conduct an independent review of papers recommended for publication and select those that are to be printed in Transactions.

The discussion was led by Paul Trumpler who said that this policy was unworkable and undesirable in so far as the Heat Transfer Division was concerned. The 12-month advance planning is too long. The timeliness of the paper might be lost. Also the Publications Committee review would reduce responsibility of the Division. The Division, he said, should be responsible for selection and review of papers. Actually, he said, where possible the Heat Transfer Division does plan and program symposiums but there are too many unsolicited papers to handle.

Prof. R. G. Folsom of the Hydraulic Division emphasized the fact that the core of the Society is the Professional Division and flexibility is therefore required.

L. N. Rowley also pointed out that many unsolicited papers were received. This sometimes would make it difficult to build a general theme. He also said that the time lag would be too great and under the new scheme padding of programs might result because of premature assignment. Also, many times the unsolicited papers are better than solicited ones.

Speaking for the new policy, W. E. Belcher said that the Instruments and Regulators Division has adopted a similar plan for the past year, and numerous symposiums have been scheduled. He cited the Frequency-Response Symposium in which authors from five different nations participated. He felt that the quality of papers was improved.

E. M. Van Winkle said that the Railroad Division also arranges symposiums and has found them to be highly desirable.

In summing up, Mr. Barker said that the new policy does what the Division wants. The Division will select the subject and chairman for each session. Since preprints are highly desirable, the 12-month period would allow for preparation time. Regarding publication, the session chairmen would be responsible for recommendations. Also, scheduling Division Conferences would permit presentation of any paper, disregarding theme. This could be accomplished singly or jointly. Mr. Barker concluded by saying that better papers of higher quality would result.

1953 ANNUAL BUSINESS MEETING

The 1953 Annual Business Meeting of The American Society of Mechanical Engineers was called to order by President F. S. Blackall, jr., on Monday, Dec. 30, at 4:45 p.m. at the Hotel Statler, New York, N. Y.

ANNUAL REPORTS

C. E. Davies, secretary ASME, presented the annual report of the Council (see pages 54–59) and called attention to the annual report of the Finance Committee (see pages 60–63), and the annual reports of other committees to the Council, which are available on request. He also entered into the record a statement as to the property owned by the Society. On motion these reports were received.

S. C. Williams, chairman of the Finance Committee, presented the report of the Finance Committee which, on motion, was received and approved.

On motion, all actions of the Council, Finance Committee, and the other committees were "ratified, confirmed, and approved."

The Secretary reported that 3550 new members had been added to the Society rolls during the year and presented a list of 250 members who had died during the year. The list included four Honorary Members, Harvey N. Davis, Dexter S. Kimball, Gano Dunn, and Arthur M. Greene, Jr., and three past officers, John Hunter, Spencer Miller, Sr., and Walter S. Finlay, Jr.

CONSTITUTIONAL AMENDMENTS

President Blackall called for the results of member ballot vote on amendments to the Constitution. These amendments, he said, dealt with changing the designations of membership grades of Junior Member to Associate Member, and of Associate to Affiliate, in line with recommendations of Engineers' Council for Professional Development looking toward uniform designations of membership grades in the ECPD constituent societies. The second change effected by the amendments provides an increase in the number of years of responsible charge as a requirement for eligibility, including an equivalent in years of practice for those who hold a license to practice. The Secretary reported that 15,978 ballots were cast, of which 107 were defective. Of the 15,871 valid ballots, 15,359 were in favor of the amendments and 512 opposed. The President declared the amendments to be in effect.

OFFICERS FOR 1953–1954 DECLARED ELECTED

The Secretary presented the report of the tellers of Election of Officers for 1953–1954. The new officers were declared elected and were introduced by the President. They are: Directors at Large, Frank L. Bradley and Robert B. Lea; Vice-Presidents, Willis F. Thompson (Region I), Thompson Chandler (Region V), William G. McLean (Region III), Vernon A. Peterson (Region VII), and Clifford H. Shumaker (Region VIII).

Mr. Blackall then introduced the newly elected President, Lewis K. Sillcox. Mr. Sillcox, in responding to the applause, said that he appreciated the honor which had been bestowed upon him. The greatest responsibility, he declared, would be to carry on "the heritage that has been established by men such as Mr. Blackall and the other past-presidents." He accepted the responsibility humbly, he said, and was "going to try to do a job with your help." (See MECHANICAL ENGINEERING, September, 1953, pages 754–757, for brief biographies of the new officers.)

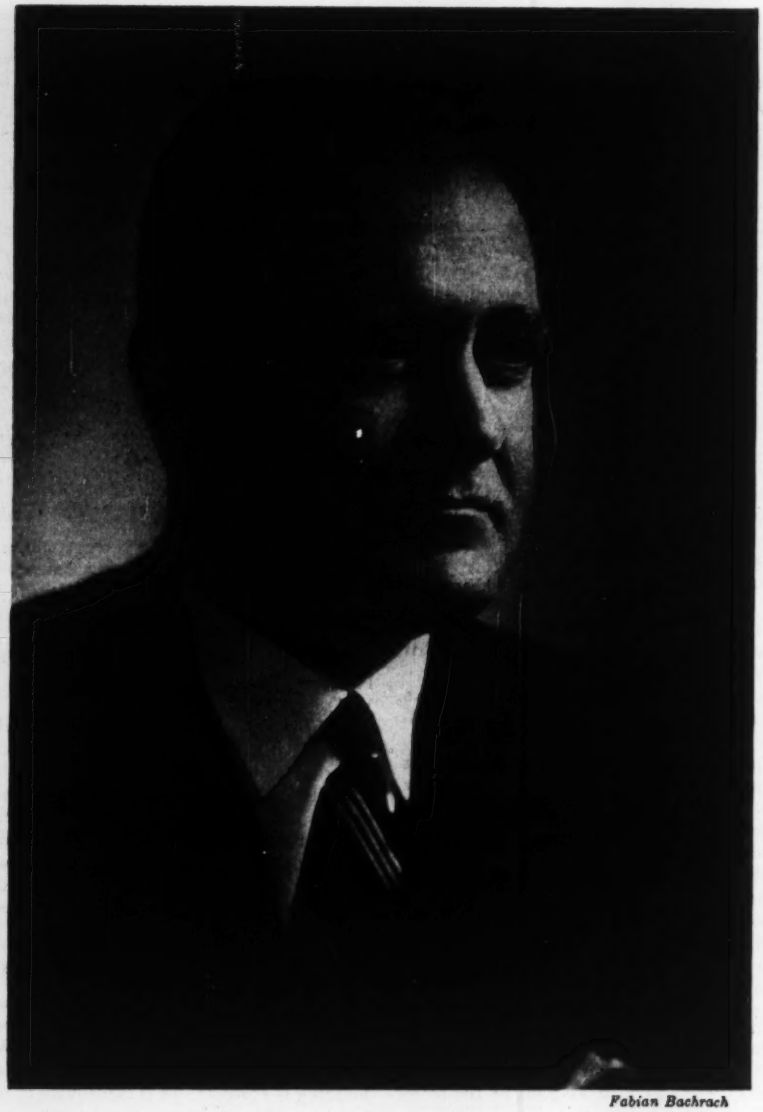
NEW ENGINEERING SOCIETIES HEADQUARTERS

Mr. Blackall then introduced the subject of a new Engineering Societies Headquarters. He said in part: "As you know, the headquarters are now located at 29 West 39th St. in New York, in a building which is about forty-seven years old. The building is obsolete. It is inadequate in size. We have to rent space outside to take care of requirements. In many respects, it would be difficult, if not impossible, to modernize it effectively.

"The United Engineering Trustees, which group represents the four Founder Societies in the administration of the Carnegie Endowment Fund, which made this building possible, and which has charge of all matters relating to the building, has been considering for a long time past what should be done about it."

He then introduced R. F. Gagg, ASME representative on UET, former chairman of UET, and currently chairman of the UET Real Estate Committee, who read a prepared manuscript. At the conclusion of Mr. Gagg's exposition of the problem, Mr. Blackall continued: "This is a very weighty problem, and it has been discussed at great length by the Council which you have elected to represent you, and undoubtedly will be the subject of many, many, more discussions.

"I want to stress the fact that despite anything that you read or may have read in newspapers or elsewhere to the contrary,



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Frederick S. Blackall, jr.

Retiring President of The American Society of Mechanical Engineers for 1953

nobody has the vaguest idea what is going to be done, or where a new headquarters, if any, is to be located.

"It did appear to your Council that it would be a great tragedy for us to break up a happy marriage of forty-seven years standing which exists among the Founder Societies. It is tremendously important in the interest of unity of purpose and action among all of the engineering profession that we stick together; and to that end, Council today unanimously, after great discussion, let me say, running to several hours, took the following actions:

"First, it adopted a declaration of intent which reads as follows: 'Voted, that to promote the interests of its members and to achieve increased unity among engineers, the ASME declares its intent to continue with the societies now comprising UET and with other educational and scientific organizations, for the purpose of acquiring and operating a national engineer-

ing center at such a location as may be agreed upon as desirable.'

"We then turn to the question of how we should go about making a decision when the time comes, and that time is not at hand yet, as to what should be done. That decision will involve many discussions. It will involve a lot of research. It actually will not involve one decision but many decisions. And whatever decision is finally made, or series of decisions on this question, will of necessity be a decision of that type which we in engineering and business must constantly make where there are perhaps fifty-one reasons why you should do something, and forty-nine reasons why you shouldn't; but you have got to do something, so you adopt the 51 per cent decision, and then proceed to give it 100 per cent of your support.

"A problem of this sort needs to be handled by a well-informed group which can develop the information necessary, haggle it out, talk it over, look at all facets of the problem, and finally arrive at a wise and proper move.

"The By-Laws of our Society provide that any matter involving a change of major policy should be submitted to the Society by letter ballot. It seems obvious that this job has got to be done by Council. It would take not one but countless letter ballots to resolve all of the problems and make all of the decisions which will have to be made over a period of some months yet to bring this thing to a definite conclusion.

"It will involve legal decisions. It will involve securing a declaratory judgment from the Supreme Court of the State of New York, and probably a friendly suit to sustain the validity by litigation of whatever judgment they hand down.

"I just mention this background to give you the basis for the following vote which was adopted by Council today. It was voted that the Council direct that a letter ballot be submitted to the membership on which the following question be asked: 'Do you approve vesting in the Council the authority to decide for the ASME at such time and place and in such manner as the Council may elect, such changes, if any, in Society's headquarters location as the Council may deem to be in the best interest of the Society and in keeping with its dignity and traditions?'

"That vote has been adopted by Council, and a letter ballot to that effect will be distributed to you shortly. I earnestly hope that the vote will be overwhelmingly in support of such a motion vesting such authority in Council, for this reason among others: That the decisions which have to be made and the contracts which arise out of these decisions must be watertight from a legal point of view, and if some group, some authority, is not vested somewhere to do these things, we have chaos, and we just cannot do them.

"I earnestly bespeak your support for the authority to vest in Council the decision as to what we should do about these matters.

"However, the decision is not at hand. The moment of decision is here, but a lot of things have got to be done. UET will proceed to get formalized the various proposals which have been made by various cities and groups, and so forth, look them all over, look at the legal aspects of the question, the financial aspects of the question, and the administrative aspects of the question; and in due course, with all possible dispatch, I am sure UET and the vested authorities will sit down to resolve the issues."

RESOLUTION OF THANKS

On motion of J. W. Barker, a resolution of appreciation was voted to all persons who contributed to the success of the 1953 Annual Meeting.

OTHER BUSINESS

On motion by Henry H. Snelling, it was voted to include in the list of ASME officers and Council members which appears in meeting programs the names of persons who are entitled to a seat on the Council without vote. Mr. Snelling also commented on the Nominating Committee and its procedures.

The Business Meeting concluded with some remarks by President Blackall in which he expressed the satisfaction his term of office had brought him and his gratitude to the members for giving him the opportunity of serving them as president.

DINNERS AND LUNCHEONS

LECTURERS HONORED AT PRESIDENT'S LUNCHEON

Seven engineers, chosen to represent The American Society of Mechanical Engineers as lecturers because of distinction in their respective fields, were presented with certificates of recognition at the President's Luncheon on Monday.

The engineers honored were Earle Buckingham, professor-emeritus in the department of mechanical engineering, Massachusetts Institute of Technology, for his lecture, "Dimensions and Tolerances for Mass Production"; Jacob P. Den Hartog, professor of mechanical engineering, Massachusetts Institute of Technology, for his lecture, "Vibration"; Clayton O. Dohrenwend, research engineer, department of mechanics, Rensselaer Polytechnic Institute, for his lecture, "One-Hundred Years of Scientific Achievement in Mechanics of Solids"; Charles Lipson, engineering consultant of Detroit, for his lecture, "Stress and Vibrations Problems in Industry"; Glenn Murphy, head of the department of aeronautical engineering, Iowa State College, for his lecture, "Problems of Nuclear-Power Development"; Jesse Ormondroyd, professor in the college of engineering, University of Michigan, for his lecture, "Vibration Measuring Instruments"; and Irwin Vigness, head of the Shock and Vibration

F. S. BLACKALL, JR., THE OUTGOING PRESIDENT OF ASME, CONGRATULATING LEWIS K. SILLCOX, THE NEW PRESIDENT

AT THE PRESIDENT'S LUNCHEON

Lewis K. Sillcox, ASME President-Elect, Prof. O. A. Saunders, Representative of the President of The Institution of Mechanical Engineers, Great Britain, and Mrs. Charles M. Hickox, President of the ASME Woman's Auxiliary.)

Branch, Naval Research Laboratory, Washington, D. C., for his lecture, "Problems of Mechanical Shock and Vibration of Concern to the Armed Services."

Of the seven, C. O. Dohrenwend, Glenn Murphy, and Jesse Ormondroyd were present to receive the certificates.

In addition, Fellow certificates were presented to the following: F. L. Bradley, plant engineer, Forstmann Woolen Company, Passaic, N. J.; R. M. Hardgrove, research consultant, The Babcock & Wilcox Company, Alliance, Ohio; Herman Weisberg, mechanical engineer, Public Service Electric and Gas Company, Newark, N. J.; R. P. Moore, Niagara Mohawk Power Corporation, Buffalo, N. Y.; and Arnold Weisselberg, consulting engineer, Long Island City, N. Y.

R. J. S. Pigott, a past-president and Fellow of ASME, acting as toastmaster, introduced Mrs. Charles M. Hickox, president, ASME Woman's Auxiliary. She gave a brief history of the Auxiliary's organization, citing the work being done on providing free educational funds as an important phase of the Auxiliary. The funds maintained include the Calvin W. Rice Memorial Scholarship Fund, the Sylvus W. Farney Scholarship Fund, and the Educational Loan Fund.

PRESIDENT BLACKALL REVIEWS YEAR

In his farewell address, President Blackall reviewed the more urgent problems of ASME and proposals with which he was associated during the past 12 months. Brief excerpts from some of the topics in his talk follow:

"MECHANICAL ENGINEERING shortly will appear in a new type face, larger and more legible. A more liberal policy has been adopted through the coupon method of free distribution of preprints. Steps have been taken to speed up the process of acceptance or rejection of papers submitted for publication.

"There was a growing feeling in certain quarters that the make-up of Council did not give adequate representation to the specialized interests of the Society, such as the Professional Divisions, the Standards and Codes Committees, etc. The matter was discussed at length in Executive Committee and Council meetings. In general accord with the tentative conclusions reached, the Organization Committee, at its meeting on Nov. 17, 1953, has proposed some far-reaching changes in the composition of the Council, which, if adopted, would assure that that body at all times would be broadly representative of all of the diverse interests which exist within our Society. In brief, it is proposed that the Council be enlarged from 22 to 24 members, with some further concurrent changes in the method of selection of individual directors.

"A new office should be created of First Vice-President, with provision, either by Society law or tradition, for this official to serve for one year in this office, and then to become President of the Society. During his term of presidential apprenticeship, so to speak, he will have an opportunity to share with the President some of the public appearances which are requisite, and some of the travel, and especially to work with and assist the President in his study and appraisal of administrative problems and procedures. If this were done, by the time the Vice-President stepped into the top spot, he would have his ideas well marshaled and be able to swing into action on a program which would enable him to bring to completion the platform of the previous administration and inaugurate new ideas of his own, already well formulated and tested by thorough examination with the previous President.

"The organization chart of our Society, in my judgment, should provide for the mandatory service at all times of at least two and possibly three Assistant Secretaries, who should carry out much of the administrative work of the Society, dividing the task up among them functionally and perhaps with some rotation of functions. They should be men of such potential that the Secretary could delegate many of his own problems to them, thus allowing himself more time and latitude for the consideration of questions of broad policy and long-term import. The men appointed to these posts should be of such cali-

PRESIDENT BLACKALL AND PAST-PRESIDENT PIGOTT WITH A GROUP OF ASME LECTURERS AT THE PRESIDENT'S LUNCHEON

(*Left to right:* F. S. Blackall, jr., Glenn Murphy, Jesse Ormondroyd, C. O. Dohrenwend, and R. J. S. Pigott.)

ber that they could be considered as potential secretarial material in the event of the death or retirement of the Secretary.

"Unity within the engineering profession is a hot topic and every president for the past several years has been importuned by a substantial cross section of the membership to bring this about in greater degree than now exists. There are those who would promote these ends through the establishment of some sort of an omnibus or overriding society, which would take in engineers in every field of professional endeavor, for the purpose of serving and representing all of them. For my part, I believe that the unity achieved through intersociety co-operation is a much more effective one. But we can do a much better job than we are doing—and this applies to the other Founder Societies as well—to promote and foster intersociety activity.

"There is one field in which a mouthpiece is needed for the general profession of engineering in all of its branches, and that is in the matter of government and political relationships. The Engineers Joint Council was established some years ago to provide for this need, and it has made effective progress to that end. I believe that it will improve in the performance of these functions, and the Founder Societies and its other members should give it the utmost opportunity to do so by avoiding quasi-political questions like so much poison and referring them, when they arise from time to time, promptly and completely to EJC.

"A broadened and more effective public-relations policy has been under consideration by the Society for some time past. I believe that the administration of the public-relations function should be given recognized status within our Society, either by retaining a professional public-relations counsel to deal with the matter, or appointing a competent public-relations executive as a member of our staff on a full-time basis, or both. This is a broader problem than merely securing press notices of meetings and the like. That is important too, but it is only one phase of the much broader need of explaining our objectives and accomplishments continuously and effectively to the general public.

"One of the pressing problems which face the four Founder Societies is that of finding new headquarters. The present Engineering Societies Building in West 39th Street, New York, was completed in 1906. While it has served its purpose admirably over the years, the space available is far from adequate today to house the administrative staffs required to serve 142,000 members within the four Societies. This membership has grown nearly tenfold since the structure was built. Furthermore, the facilities in many respects have become obsolete or are in imminent need of costly repairs or reconstruction. The United Engineering Trustees, who own and operate the building on behalf of the four Societies, are studying the matter actively."

INSTRUMENTS AND REGULATORS LUNCHEON

Pioneers and workers in the rapidly growing field of frequency response were among those attending the Instruments and Regulators Luncheon on Tuesday, a high light of the Frequency-Response Symposium program scheduled this year by the IRD Dynamic Systems Committee. Symposium speakers from five different countries who were attending the luncheon were introduced to the audience.

One of the main features of the luncheon was the presentation of an award to Herbert W. Ziebolz, vice-president of engineering, Askania Regulator Company, Chicago, Ill., for distinguished service in the field of automatic control. William G. Brombacher, chief, mechanical instrument section, National Bureau of Standards, Washington, D. C., retiring chairman of the IRD Executive Committee, was presented with an engraved certificate for his service with the Division.

There were two speakers on the luncheon program, both of them pioneers in the frequency-response field. Harry Nyquist, assistant director of system studies, Bell Telephone Laboratories, New York, N. Y., the father of the famous Nyquist rule for stability, spoke briefly on his 1932 paper on regeneration theory and how he happened to write it. This paper contributed largely to the opening up of the field of frequency response. Dr. Nyquist wanted to explain the mathematics of amplifiers. In this paper he gave a simple graphical way of determining the conditions when amplifiers will not sing. Dr. Nyquist's paper made a contribution of great magnitude to the communications field and to other fields relating to frequency response.

The second speaker at the luncheon was Albert C. Hall, technical director, research laboratories, Bendix Aviation Corp., Detroit, Mich., who spoke on the "Early History of the Frequency-Response Field." According to Mr. Hall it was as a

HEAD TABLE AT INSTRUMENTS AND REGULATORS LUNCHEON

(*Left to right:* Ralph Claridge, John Hrones, Steven Higgins, Albert C. Hall, *speaker*, Harry Nyquist, *speaker*, Rufus Oldenburger, *chairman*, Samuel Eskin, Lee Mason, Herbert Ziebolz, W. F. Belcher, W. G. Brombacher, C. E. Mason, and W. A. Wildhack.)

result of working on military problems that the frequency-response field began to advance. In 1940, he said, work in the automatic control field was instituted at Bell, M.I.T., and Sperry, to meet particular military problems which needed solutions. This was done under the military and under OSRD. At that time, he declared, we did not have a good over-all grasp of the feedback-control problem. We were given these military problems which we had to find solutions for one way or another, and as a result there was a growth of understanding of this field.

There were three separate problems which came about during the war which caused the growth of the frequency-response field, said Mr. Hall. The first one was that of just more accurate gun-laying—getting the accuracy to control larger guns. This problem was solved satisfactorily. The same kind of accuracy of gunfire was needed aboard ship when the ship was rolling, which presented a problem that was a bit more difficult to solve.

The second problem, said Mr. Hall, was radar tracking—a real problem which caused some of us to look for help in the communications field. By using some communications techniques and some of Dr. Nyquist's theories, we got a much better understanding of what we could do.

The third kind of problem which gave an impetus to the frequency-response field was the guided-missile problem. This problem was extremely complex. By use of careful analysis techniques we were finally able to get to the point where we could call our shots and this was a great advance.

We have made very extensive use of analog computers in this work and they have been a tremendous help to us, said Mr. Hall.

Since the end of the war the feedback field has really grown because of the military problem and because of the additional and growing problems in the process industries and in the machine-tool industry. Frequency response is a growing business

ENGINEERS FROM OVERSEAS, AUTHORS OF PAPERS IN FREQUENCY-RESPONSE SYMPOSIUM

(*Left to right:* V. Oja, Sweden; Dr. Hans Sartorius, Germany; A. R. Aikman, England; J. M. L. Janssen, Holland; Dr. R. C. Oldenbourg, Germany; Dr. M. J. Pélegrin, France; Dr. J. H. Westcott, England; R. H. MacMillan, England; J. M. Loeb, France.)

UNITED STATES ENGINEERS, AUTHORS OF PAPERS IN FREQUENCY-RESPONSE SYMPOSIUM

(*Left to right:* Dr. Rufus Oldenburger, C. H. Thomas, Harold Chestnut, Abraham M. Fuchs, S. L. Gillespie, D. W. St. Clair, and Walter R. Evans.)

and is reaching more and more into every line of endeavor, said Mr. Hall.

S. G. Eskin, technical adviser, Dole Valve Company, Chicago, Ill., presided at the luncheon.

HEAT TRANSFER LUNCHEON

Prof. O. A. Saunders of the University of London, England, spoke on "International Trends in the Science and Art of Heat Transfer" at the Heat Transfer Luncheon, Tuesday, December 1. He said there were many gaps in the engineering knowledge of heat transfer and some uncertainty in the results of most experiments in this field. The uncertainty is caused partly by errors and partly by variables which are not fully understood, such as inlet effects, preconvection, and swirl. Variables, he pointed out, may not always be what they seem.

AT INSTRUMENTS AND REGULATORS LUNCHEON

(*Standing:* Herbert Harris, N. B. Nichols; *sitting:* A. C. Hall and H. Nyquist, both of whom were speakers at the luncheon.)

There are several branches in heat transfer where knowledge is lacking. Professor Saunders mentioned two in particular: matrices, and rotating surfaces. Some work has been done on matrices, but only a little on rotating surfaces, and there are many unanswered questions in both. He also felt that much work needs to be done on heat transfer at or near the speed of sound; and in viscosity and thermal conductivity, there is too much variation between textbooks. There are also many gaps in the knowledge of radiation, particularly the radiation from luminous flames. This subject is being studied, with international co-operation, by France, Holland, England, and the United States. Important developments have been made recently in three fields, he said: regenerators, gas-turbine-blade cooling, and liquid metals.

Professor Saunders pointed out that the biggest difference between heat-transfer research done in England and in this country is that here most of the work is done in universities and in England most of it is sponsored by the government. As a result, the outlook in England is a longer-term one than ours. He felt that we could benefit from a longer outlook than the short-term one we have.

P. R. Trumpler, who presided at the luncheon, presented a Certificate of Award to A. C. Mueller in appreciation of his work for the past five years on the Heat Transfer Executive Committee. Last year Mr. Mueller was the chairman of the committee.

The incoming President of ASME, L. K. Sillcox, spoke briefly of his respect of, and need for, the work of the Heat Transfer Division.

AVIATION—GAS-TURBINE POWER LUNCHEON

A joint Aviation and Gas Turbine Power Division luncheon was held on Tuesday to commemorate the 50th Anniversary of Powered Flight and honoring the engineers' contributions to powered flight. President Blackall opened the program by extending his greetings and briefly reviewing the work of the ASME Aviation Division. He mentioned specifically the air-

cargo days and the heavy-press program, which have been significant features of ASME meetings.

A high light of the luncheon was the presentation of a certificate (see frontispiece) to Dr. W. F. Durand, a past-president and Honorary Member ASME, for his great contributions to aeronautical science and to its engineering application to useful purposes. The special citation was presented to Dr. Durand by Dr. Jerome C. Hunsaker, Honorary Member ASME, professor of aeronautical engineering, Massachusetts Institute of Technology, Cambridge, Mass.

I. I. SIKORSKY, PRINCIPAL SPEAKER

The main speaker at the luncheon, Igor I. Sikorsky, described the years 1903 to 1909 as the "childhood of aviation." While many inventors and flying enthusiasts were interested in powered flight, the first actual engineering contribution was made by the Wright Brothers, he said. They analyzed the problem and found methods to solve it. Aviation's infancy was concluded, Mr. Sikorsky said, by a flight in 1909 across the English Channel, a distance of 22 miles.

Taking a long jump, the maturity of aviation, according to Mr. Sikorsky, is symbolized by Lindbergh's flight across the Atlantic.

Now, fighter planes are exceeding speeds of 1300 mph and, he predicted, speeds of 2500 mph will be attained within the next five years.

Another sign of maturity was the minimum slow speed that a plane could fly or hover. The development of the helicopter solved this problem. He cited the work of the helicopter in Korea—evacuating wounded service men, rescuing men from behind enemy lines, and general short-haul operation, where necessary.

As to the future, Mr. Sikorsky envisions the possible application of atomic energy for rocket propulsion, thereby making space travel a reality.

Roy T. Hurley, chairman, and president, Curtiss-Wright, Wright Aeronautical Division, Woodridge, N. J., presided at the luncheon.

In addition to ASME, the luncheon was cosponsored by the Institute of the Aeronautical Sciences, Society of Automotive Engineers, and the National Security Industrial Association, Inc.

JEROME HUNSAKER INTRODUCES DR. DURAND PRECEDING PRESENTATION CEREMONIES

FUELS LUNCHEON

In his talk presented at the Fuels Luncheon, Tuesday, December 1, on Power Today and Tomorrow, Alfred Iddles, president of The Babcock & Wilcox Company, traced the advances made

AT THE AVIATION LUNCHEON

(*Left to right:* Charles J. McCarthy, president, Institute of Aeronautical Sciences, F. S. Blackall, jr., outgoing President ASME, Roy T. Hurley, and Robert Cass, President, Society of Automotive Engineers.)

SCROLL HONORING DR. W. F. DURAND IS PRESENTED TO HIM BY JEROME HUNSAKER, AS BRIG-GEN. F. P. LAHM, USAF (RET.), *extreme left*, AND ADM. JOHN T. POWERS, U.S.N. (RET.), *extreme right*, LOOK ON

AT THE "50 YEARS OF POWERED FLIGHT" EXHIBIT, ARE, *left to right*, ROY T. HURLEY, GENERAL LAHM, BRIG-GEN. K. D. METZGER, AND DR. HUNSAKER

DR. W. F. DURAND (*left*) IS INTRODUCED BY JEROME HUNSAKER AT THE AVIATION LUNCHEON

DR. W. F. DURAND RESPONDING UPON RECEIPT OF SCROLL

ADMIRAL POWERS, *left*, AND GENERAL LAHM AT AVIATION LUNCHEON

IGOR I. SIKORSKY SPEAKS ON AVIATION, 1909–1969

in power from the crude low-pressure, low-temperature steam engine of James Watt in order to draw some conclusions concerning the probable direction for development work in the next few years.

Power in the past moved from the realm of the slave and the animal to that using steam some 200 years ago, largely in England where the steam engine had its early beginnings. With the introduction of the electric generator by Edison in America the limitations of pressure and temperature were somewhat relaxed, but even so the size and efficiency of the early electric plants were extremely low.

The introduction of electricity produced a period of rapid development. The question of efficiency became more and more important. Increased quantities of fuel that were needed brought into being crude stokers and boilers with pressures as high as 150 lb. In 1905 the superheater was introduced because at that time the steam turbine, in its infancy, showed promise of greatly increased size and efficiency.

The generation of higher pressures to 1250 lb and 750 F had its beginnings at the Edgar Station in Boston, Mass. The size of units increased rapidly until today the average size of utility boilers is in the order of a million pounds of steam per hour. The development of reheat has progressed in five years from approximately 10 per cent of units until today some 90 per cent are reheat.

The improvement in size and efficiency of electrical production has grown at an increasing rate as a result, Mr. Iddles stated, of

American ingenuity, primarily, and an American characteristic wherein there are relatively few inhibitions. He further remarked that progress came about because the usual engineer in the utility field, and of course in the corresponding types of installations in industry, assumes that no job for next year should be an exact duplicate of last year's job. This, he added, stems from engineers with imagination and interest in how to improve their products.

Mr. Iddles also made note of one other important aspect of the situation. A rather characteristic American habit is the matter of co-operation between the user of equipment and the manufacturer of equipment. In the early days utility engineers would get together and discuss their latest designs and operating results and freely give to each other information which would be of use in improving their results. This resulted in formation of the Prime Movers Committee.

He then paid tribute to the role ASME and AIEE have played throughout the years as places where engineers could gather and discuss engineering questions in the power field leading to quick dissemination of knowledge throughout the United States. The result has been a degree of development which today is not equaled anywhere in the world.

"Now let's look at the present for a moment," said Mr. Iddles. "We have pulverized fuel developed to a considerable extent, perhaps almost to the limit of possibilities. We have single reheat jobs by the dozen, we have double-reheat jobs under consideration and one under construction."

With increasing size and concentration of units and large quantities of fuel burned in metropolitan areas, he said, the problem of ash disposal and collection has arisen. A development, quite radical in comparison with pulverizing coal, but which promises to assist greatly in this ash problem is the cyclone furnace of which a considerable number are in operation.

Since we now have arrived at the approximate upper limit of pressure for the normal type of boiler, Mr. Iddles pointed out, and since there are thermodynamic possibilities in using steam pressures much above the critical of 3200 lb, and this in turn offers possibilities for double or triple reheat and temperatures still higher than 1050 deg, we are on the edge of a new period of development.

Entirely aside from cycle efficiency, there are problems of design which will materially improve power-production practice. Mr. Iddles stated that we may expect on the average to have larger units which produce at lower cost and with a lower installation cost, and with somewhat lower labor cost for operation.

In conclusion, while he made no prophecy, he touched on the potential usefulness of the heat which can be obtained by fission of the atom. The early problems in the development of modern power, using ordinary fuels, involved many headaches. Then he added that at the moment we probably are in those early stages for atomic energy.

The luncheon program was conducted by John R. Michel, chairman of the Fuels Division, who at the conclusion of the program was presented with a certificate of appreciation from the Society for his work as chairman of the Division by Richard B. Engdahl, supervisor, Battelle Memorial Institute, Columbus, Ohio.

APPLIED MECHANICS DINNER

A progress report on the National Science Foundation was given by Dr. Ralph Morgan of the Foundation at the Annual Dinner of the Applied Mechanics Division on Tuesday. Until now, he said, the Foundation has not had the funds to make an impression on the country. For example, in 1950 the National Science Foundation appropriation amounted to $350,000; in 1951–1952, about $3,000,000; in 1952–53, about $4,500,000; and in 1953–1954, over $8,000,000. Its primary job is to develop a national science policy and to find out more about Federal support of research, research by universities, and industrial research.

Research in the engineering colleges, Dr. Morgan said, embraces a Fellowship program and a grant program. Engineering-wise the National Science Foundation has no mission to perform except that of research and education. In evaluating a project it must be sound and have educational values, he said.

According to Dr. Morgan, a minimum grant amounts to about $8000 per grant per year. This would cover such items as support of the investigation during the summer months, support of graduate students at a proper level, cost of permanent equipment, and miscellaneous items such as travel to professional society meetings, and the like.

Turning to the Applied Mechanics Division's business, Dana Young, who presided, called on J. M. Lessells and Martin Goland to report briefly on the *Journal of Applied Mechanics* and *Applied Mechanics Reviews*, respectively. Dr. Lessells stated that the *Journal's* reputation is still growing because of the type of material being published. He warned, however, that many of the papers are rather lengthy and that perhaps the same substance of a paper could be written in shorter form. He also pointed out that "Design Data" are being published in separate booklets and asked for more contributors to this section. Another feature of the *Journal* cited by Dr. Lessells is the letters-to-the-editor section.

Mr. Goland introduced Dr. Stephen Juhasz, who was recently appointed as executive editor of AMR, to the audience. Looking ahead, Mr. Goland indicated that the *Reviews* will cover new fields and scan more journals, thus giving increased coverage to the engineering profession.

Prof. Jesse Ormondroyd announced that the Second U. S. Congress of Applied Mechanics is to be held June 14–19, 1954, at the University of Michigan, Ann Arbor, Mich. He called for more acceptable papers for the conference and also for sponsors. Professor Ormondroyd said that he will ask for $300 subsidies from interested colleges, companies, and institutions, to defray the cost of printing a proceedings of the conference. He asked that authors submit their manuscripts by January, or at the latest, two months before the Congress.

Reporting on the Division's papers' status, Prof. N. M. Newmark said that 160 new papers were handled during the year, the greatest number to date. He pointed out that 37 are still being reviewed, 55 were rejected, 16 were used as "Brief Notes," 2 as "Design Data," and 50 have been accepted for presentation at meetings.

As part of the dinner program, Professor Newmark, as incoming chairman of the Division, presented Dana Young, the outgoing chairman, with a certificate of appreciation for his five years of service.

HONORS LUNCHEON AND ROY V. WRIGHT LECTURE

Three new honors in recognition of the mechanical engineers' part in the machine-tool industry were awarded for the first time at the Honors Luncheon, which was held on Wednesday, December 2. This occasion was further marked as one of the outstanding events of the Annual Meeting with the presentation of the Gantt Medal to Thomas E. Millsop, president of the Weirton Steel Company, who later delivered the Roy V. Wright Lecture.

"Better things for more people at lower cost," said Herbert L. Tigges, president of the National Tool Builders' Association, "is the foundation of the machine-tool industry," by way of explaining how NMTBA came to set up the ASME Machine-Tool Design and Economic Value Competition Awards. The awards were established to be given to three ASME

HEAD TABLE AT HONORS LUNCHEON DURING 1953 ASME ANNUAL MEETING

authors of the best papers on the general subject dealing with problems in the design or application of machine tools, or their more effective use in reducing production costs, or increasing accuracy of work done, or their economic importance.

Mr. Tigges said, "The point is that we in the United States have come to expect a constant advance in the standard of living as a matter of course. We take it for granted that next year more people will be able to buy better things in return for what they get paid for their day's work, than they can this year. . . . By contrast, in this country, progress is not only expected—it is the very foundation of our entire business and economic and social structure."

He pointed out that competition compels manufacturers to seek ways and means of reducing cost and emphasized that the primary method of reducing costs is to increase productivity. "I believe that the major factor in increasing productivity is better machine tools. Socially speaking, the machine-tool industry exists in order that more people may be provided better things at lower cost. In order to stay in business, in order to fulfill our function in the American scheme of things, we must constantly devise machine tools today that are better and more productive than the ones we built yesterday."

"Better and more productive machine tools," he added, "is the job of the mechanical engineer. Progress in the art of removing metal depends chiefly upon the time and effort expended by engineers in research and development work in this field.

"That is why our Association considered it important and appropriate to offer awards such as these," Mr. Tigges said, believing that, "outstanding accomplishment in this field should be honored by special recognition."

Following the talk by Mr. Tigges, executive vice-president, Baker Brothers, Inc., Toledo, Ohio, the machine-tool design and economic value awards were presented to: First, Ernest Wildhaber, Fellow ASME, mechanical engineer, Rochester, N. Y., for his paper, "Manufacture and Application of Gleason Toothed Face Couplings and Clutches"; second, Robert R. Slaymaker, Mem. ASME, professor of machine design at the Case School of Applied Sciences, and consultant for the Cleveland Graphite Bronze Company, Cleveland, Ohio, for his paper, "Bearing Design Using Concentric Journal Theory"; and third, to Carroll R. Alden, Mem. ASME, research engineer with the Ex-Cello-O Corporation, Detroit, Mich., for his paper, "Electrospark Machining."

THOMAS E. MILLSOP DELIVERS WRIGHT LECTURE

Mr. Millsop, in being presented with the Gantt Medal in recognition of his outstanding community work on behalf of ASME and the American Management Association, was cited by J. Keith Louden, Mem. ASME, as "industrialist, educator, humanist, and public official whose life has been dedicated to selfless service to others."

As an industrialist, Mr. Millsop, who has been president of Weirton Steel Corporation since 1936, has instituted policies of great benefit to the company's employees and their families. In 1949 the National Council on Rehabilitation conferred an Award of Merit on him for his work in rehabilitation. Over one thousand wounded veterans of World War II were returned to their regular Weirton jobs, irrespective of the extent of their disabilities.

In 1947, when four communities consolidated to form the present city of Weirton, Mr. Millsop was urged to run for mayor. Although he made no campaign, he was nominated and elected by a five-to-one majority. He was re-elected in June, 1951, for a second four-year term. Among the civic projects organized and carried out under his guidance were a million-dollar community-center building and city recreation program, a three-million-dollar general hospital, the extension of a city water supply and sewer system to the entire community and the improvement of streets and sidewalks, and extension of the street-lighting system in Weirton.

After the presentation of the Gantt Medal to Mr. Millsop, he was "introduced" by F. S. Blackall, jr., outgoing ASME president, as the Roy V. Wright Lecturer. Mr. Millsop chose as the topic of his paper, "Help Wanted—For Community Service."

"The shortage of engineers in this country must be overcome," said Mr. Millsop, "if our American standard of living is to be maintained." It is Mr. Millsop's opinion that the manpower shortage in engineering can be overcome if members of the profession will help sell the future of engineering "along Main Street" and in the high schools of their communities.

"Engineers can increase the desire of young people to enter the profession by setting the right examples, by being looked up to and respected in their own communities," he said. "We are all aware that hero worship is a part of growing up—and engineers can gain the attention and respect of the young folks

AT THE HONORS LUNCHEON

(*Left to right:* Herbert L. Tigges, President, National Machine Tool Builders' Association, Frederick S. Blackall, jr., President, The American Society of Mechanical Engineers, and Tel Berna, General Manager, National Machine Tool Builders' Association.)

through 'starring' in community affairs." It follows that the engineer, by becoming a well-known and active community worker, can bring a degree of recognition to his profession, and "it is not improbable that many youngsters will want to follow in his footsteps as a good citizen and also as an engineer." He also urged engineers to take an active part in encouraging high-school students to consider engineering as a profession through school programs.

Drawing on his own experience as Mayor of Weirton, he pointed out the rewards and pitfalls of civic service and said, "it is an exacting obligation that should be accepted in good faith, a faith which will permit a man to step up to the door of his community when the sign 'Help Wanted—For Community Service' is posted and say, 'I will take that job.'"

The Roy V. Wright Lecture is published in full elsewhere in this issue.

ANNUAL BANQUET

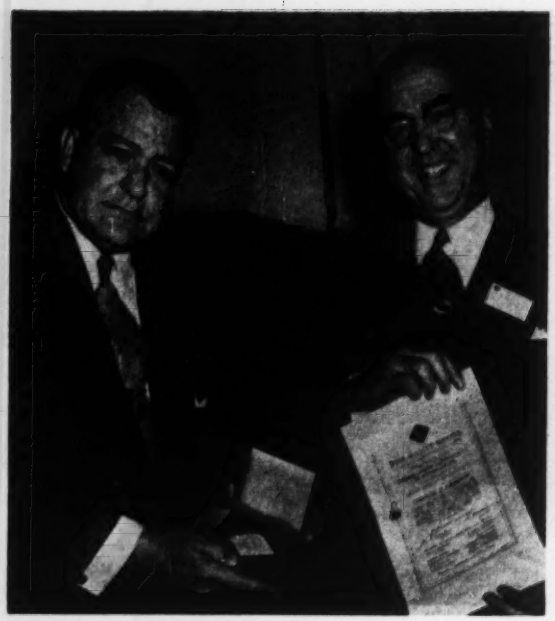
More than 1600 ASME members and guests gathered at the Annual Banquet on Wednesday to witness the traditional conferring of honors and awards on distinguished members of the profession and recognition of outstanding young engineers and leaders in the engineering world.

Acting as toastmaster, retiring president F. S. Blackall, jr., introduced C. E. Davies, Secretary ASME, who extended a welcome to distinguished guests representing engineering societies from both abroad and the United States and Canada.

The following newly elected members of Council were then

GROUP AT THE HONORS LUNCHEON

(*Left to right:* Herbert L. Tigges, Ernest Wildhaber, Robert R. Slaymaker, Carroll R. Alden, and Tel Berna.)



THOMAS E. MILLSOP, GANTT MEDALIST, AND J. KEITH LOUDEN WHO PRESENTED THE MEDAL AT HONORS LUNCHEON

introduced by Mr. Blackall: Frank L. Bradley, Thompson Chandler, Robert B. Lea, William G. McLean, Vernon A. Peterson, Louis Polk, and Willis F. Thompson.

L. K. SILLCOX, NEW PRESIDENT

Lewis K. Sillcox, the incoming ASME president, was introduced next by Mr. Blackall. In his brief remarks, Mr. Sillcox said that he was honored to accept this great responsibility and would do his utmost to carry on the excellent work of the many distinguished presidents of the past whom he follows. Mr. Sillcox is an Honorary Member of ASME and also the recipient of the 1943 ASME Medal.

50-YEAR MEMBERS

Secretary Davies then called on the following members, present at the dinner, who, for completing 50 years of membership in the Society, were presented with special 50-year membership buttons by President Sillcox: E. G. Bailey, Sanford L. Cluett, Morris L. Cooke, Carl Frederick Dietz, Hiram B. Hartwell, Arthur C. Jackson, William A. Jordan, Martin L. Katzenstein, Frederick F. Schuetz, William A. Shoudy, and D. Robert Yarnell.

The names of the following members who also reached 50 years of membership during the year, but were not present, were announced by Secretary Davies: Jerome G. Bower, William M. Chatard, Albert Crossman (deceased), Charles F. Dixon, Albert J. Gifford, Harry F. Halladay, Henry John Hanzlik, Frank A. Haughton, Arthur W. Klein, H. Leland Lowe, William T. McCoy, William H. Millspaugh, William E. Moore (deceased), Pierson M. Neave, John E. Stuntz, Franklin Sweet, Theodore H. Taft, Herbert L. Whittemore, Henry E. Worcester, and William Wraith.

MEDALS AND HONORS CONFERRED

Medals and awards were then conferred on the following:

Pi Tau Sigma Gold Medal Award to Merl Baker, for outstanding achievement in mechanical engineering within ten years after graduation.

Richards Memorial Award to Thomas M. Lumly, Mem. ASME, for outstanding achievement in mechanical engineering within twenty to twenty-five years after graduation.

Melville Prize Medal for Original Work to Jefferson C. Falkner, Fellow ASME, for his paper, "Quick-Starting of Large High-Pressure, High-Temperature Boilers."

Worcester Reed Warner Medal to William H. McAdams, Mem. ASME, for his critical research and correlation of heat-transfer data as presented in his engineering classic, "Heat Transmission," for his many contributions to engineering handbooks and technical publications; and for his tremendous influence on and inspiration to generations of students who now serve American industry. Mr. McAdams was unable to be present.

Holley Medal to Philip M. McKenna, Mem. ASME, for the discovery of principles and development of new processes in the application of distinctive types of tool materials, resulting in great improvements in metal cutting.

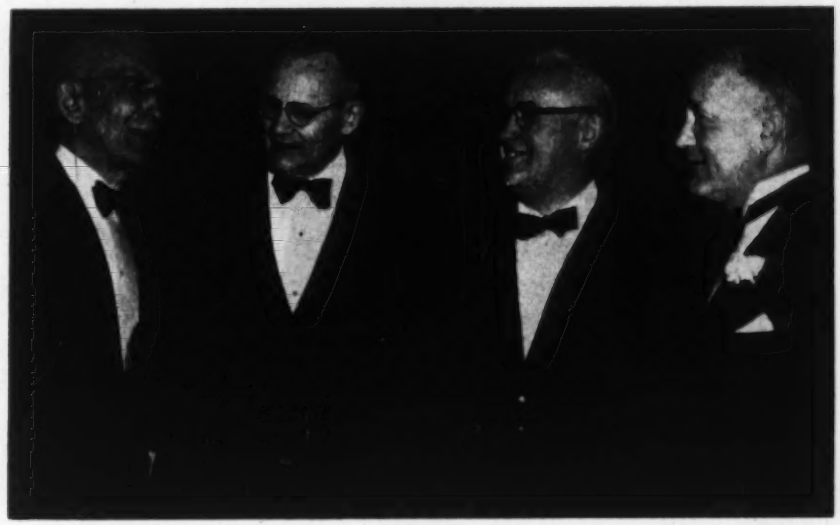
Westinghouse Medal to A. G. Christie, for his pre-eminent achievements internationally in the field of power generation, for his leadership in engineering education, and for his human qualities which have won the friendship and admiration of engineers everywhere.

ASME Medal to Crosby Field, Fellow ASME, engineer, industrialist, inventor and patriot in peace and war; uniquely exemplifying the height and breadth of achievement attainable through brilliance and diligence conforming to and promoting the highest ideals of the engineering profession.

Honorary memberships were conferred upon the following:

Edward L. Cochrane, distinguished naval officer and engineer, who through his leadership guided naval and marine engineering through a critical period of our history.

LEWIS K. SILLCOX, THE INCOMING PRESIDENT OF ASME, SPEAKING TO PHILIP M. MCKENNA, THE 1953 HOLLEY MEDALIST, AT THE ANNUAL BANQUET



Left to right: L. K. SILLCOX; CROSBY FIELD, FELLOW ASME, ASME MEDALIST; JEFFERSON C. FALKNER, FELLOW ASME, MELVILLE MEDALIST; AND F. S. BLACKALL, JR.

William A. Hanley, Fellow ASME; engineer by nature, by desire, by training, by lifelong activity—blessed himself, and blessing others, by manifold application of his great talents to the alleviation of human, civic, and educational ailments.

Alexander C. Monteith, Mem. ASME; for his leadership in planning engineering developments, and particularly for his influence upon the training of young engineers.

Sheppard T. Powell, Fellow ASME; in recognition of his meritorious contribution to public health and industrial development, benefiting mankind and advancing technology through his resolute investigations and his articulate application of engineering principles in controlling and using one of nature's primary resources—water.

William F. Ryan, Fellow ASME; for his pioneering work in a wide field of engineering in the design and management of industrial and public-utility electric-generating projects; for his contribution to the success and well-being of The American Society of Mechanical Engineers and its members; for his work in promoting engineering education and in inspiring and helping young men toward professional engineering standing; for his contribution to the work of the Engineers' Council for Professional Development; for his sterling, helpful, and attractive character.

Other honors and awards were also presented at the President's Luncheon, the Honors Luncheon, and the Members and Students Luncheon.

Further details about the award winners, medalists, and honorary members appear in an article, "ASME Honors Engineers," published on pages 64–72 of this issue.

G. A. PRICE IS PRINCIPAL SPEAKER

Addressing the annual dinner, Gwilym A. Price, Associate Member ASME, president, Westinghouse Electric Corporation, Pittsburgh, Pa., called on the nation's engineers to play a greater role in public life and to take the lead in "applying engineering principles to our social problems."

He said "the engineer is not only the ideal man for this work, but also stands in an ideal position to perform it." Yet, he added, in the past the engineer has "tended to stay clear of such commitment."

Of the 48 governors, he pointed out, none is an engineer, while only two of the 96 United States senators are of the engineering profession.

Wherever the nation's problems are physical and subject to technical solutions, they have been and can be surmounted, Mr. Price declared, adding: "Unhappily, however, many of our most dangerous problems are not physical and will not be solved by better research, high productivity, or any of the other industrial virtues. I refer to the social illnesses that afflict our age. How to cope with these is probably the most perplexing internal problem we face.

"You and other engineers hold part of the answer in your hands," he told his audience. "You have successfully applied engineering principles to industry. Now our hope lies in part in the application of those principles to our social problems."

Because he is everywhere respected for his character, competence, and record, and is welcomed by all groups, the engineer might successfully "erect a bridge between the technical and humanistic world, and bring diverse groups together into a common program as no one else is equally capable of doing."

Mr. Price also termed the present shortage of engineers in this country a "critical deficit" and one which will exist for years to come.

While the U. S. industrial productive machine has been expanded enormously Mr. Price said, economists point out that "we have merely caught up with the ground we lost in the depression, and that Soviet Russia is "amassing capital, training engineers, and building up plants at a faster rate than we."

"There is almost nothing that we cannot do, if we bend our national will to doing it," he declared, "but the first requirement of such a national effort in engineering is engineers. The deficit is now critical."

Not only must more engineers be trained, he said, but they must be intelligently used once they are trained. For the complete text of Mr. Price's address, see pages 21–22 of this issue.

MEMBERS AND STUDENTS LUNCHEON

One of the high points of the Annual Meeting this year, as every year, was the Members and Students Luncheon on Thursday which attracted more than 280 members and students from many parts of the country. F. S. Blackall, jr., who pre-

AT THE ANNUAL BANQUET

(*Left to right:* Gwilym A. Price, who delivered the dinner address; Alexander G. Christie, first ASME Westinghouse Gold Medalist; Alexander C. Monteith, Honorary Member of ASME; and F. S. Blackall, jr., the retiring president.)

sided, opened this year's luncheon program by introducing the new president, Lewis K. Sillcox, to the audience. Mr. Sillcox then addressed the audience on the subject, "Professional Prestige and the Engineer."

PRESIDENT SILLCOX SPEAKS ON PROFESSIONAL PRESTIGE

In his address, he compared the great person with the artist, saying that in painting, the traditional "grand style" issues not from the subject chosen but from the soul of the artist operating on it and creating new splendor.

The thing that the artist, be he sculptor, painter, composer, architect, or a great person, is striving to express is hidden far within the penetralia of his spirit; the object with which he is immediately concerned is but the point of departure.

An artist or a great person is striving to give us something, to communicate with us; and so the whole process becomes a kind of communion between the artist who gives and the layman who receives.

He thought of the artist as a person specially commissioned to lead and to invigorate our strange and priceless spirit and thus raise us to a realization of our own dignity.

For the time being, said Mr. Sillcox, the world is less concerned with the refinements of life than with the problem of making useful things and how best to train people in vocations profitable to the community.

The testing of our generation, he said, will be its ability to restore a portion of past splendor that has been lost. That we shall record something more than the fears and disillusionments which have been our daily fare, and that we shall produce something great that will outlive the disappointments of the present, we may permit ourselves to hope. This can occur only if our conception of life has reached a fullness of beauty sufficient to us as the artist who perpetuates it in its splendor.

MR. BLACKALL TALKS ON SOCIETY ACTIVITIES

Mr. Blackall then gave the audience a brief background of the Society and some of its activities. He spoke of its work in the maintenance of standards, of engineering education, and of its work as editor and publisher of important engineering journals, technical papers, books, and codes and standards. He stressed the fact that one of the Society's great contributions to industry and the general public was its codes, such as the ASME Elevator Code, the Boiler Code, and the Code for Unfired Pressure Vessels, which save both lives and dollars. He mentioned the contribution to national defense made by the international screw-thread accord in which ASME participated.

Some of the benefits of active participation in ASME affairs were cited by Mr. Blackall. He urged students present to make the Society an integral part of their plans for a professional career. He told them it would make them more effective engineers to the lasting benefit of their employers, their communities, and their nation.

PRESENTATION OF AWARDS

At this point in the luncheon program the awards were presented. The Postgraduate Student Award was given to George Leppert, Jun. Mem. ASME, Monsanto Chemical Company, Dayton, Ohio, for his paper, "A Stable Numerical Solution for Transient Heat Flow." The Charles T. Main Award was given to Peter Ashurkoff, 1953 graduate of Princeton University, for his paper, "The Engineer's Contribution to the Increase in the Standard of Living." The Undergraduate Student Award was won by Robert M. Bell, 1953 graduate of Queens University, for his paper, "The Sixty-Inch Vertical Boring and Turning Mill Manufactured by the John Bertram and Sons Co., Ltd." Mr. Bell was unable to be present.

ADDRESS BY MERL BAKER

The main speaker of the luncheon was Merl Baker, associate professor of mechanical engineering, and director, The Kentucky Research Foundation, The University of Kentucky, Lexington, Ky., who was the recipient of the Pi Tau Sigma Gold Medal Award. He spoke on "Balancing an Engineer."

Professor Baker began his address by quoting the following statement of a professor-emeritus of Rensselaer Polytechnic Institute: "I believe that a man should be credited with culture when he has four attributes: When he is able to see in their proper perspective the factors of the problem before him;

when he is able to have a true sense of the relative value of men and of things; when he is able to distinguish the true from the false; and jointly, a summary of all, when he has those attributes of a well-balanced mind which enable him to live intelligently in his environment." Might not these also serve as goals for the engineer, said Professor Baker.

I am becoming increasingly concerned about the engineer as an individual, he said. I wonder how many of you feel that your college curriculum prepared you for better living as well as it prepared you technically for engineering. Perhaps some of you feel that the university must concentrate on theory and technical courses and trust the individual to develop his own sense of values, integrity, personality, and the many other qualities of a well-balanced person. I believe that the very nature of the engineering program should contribute immeasurably to the cultural development if the student is aware of the fact that the same precepts of the engineering problem are applicable to intelligent living. You must see the factors of the problem before you in their proper perspective, you must distinguish the true from the false, and you must have a sense of relative values.

I contend that the graduate engineer is capable of contributing more to society than perhaps any other professional or liberal-arts school graduate because of his training. Our technical courses demand an analytical mind which I deem essential in practically every type of situation. These are the qualities that tend to balance an engineer in order that he may live intelligently and contribute substantially to his environment.

However, all too frequently the engineer does not take time nor make the effort to contribute his fair share to the civic and social betterment of mankind.

There are many ways in which we may broaden our background and thereby become better balanced individuals, said Professor Baker. Master the ability to get along with people, he told his audience, and you will find yourself enjoying life more.

It would be unfair to assume that the engineering schools could make a well-balanced engineering graduate from every piece of source material available, he said. Nevertheless, we possibly could reduce the number of low-grade engineers by strengthening our graduation requirements.

In some cases it is the employer who contributes to the unbalance of an engineer by failure to give him opportunities to develop and advance. It is sometimes too easy for an employer to classify and treat engineers as technicians rather than professional men.

Lack of pride in his profession produces a cavity in the development of an engineer. Possibly, if engineering students and young engineers were better informed, this problem would be alleviated. It is seemingly a joint project for the educator, employer, and professional engineer. Let all of us accept our responsibilities and strive to execute them in order to produce better-balanced engineers and a stronger America.

AMERICAN ROCKET SOCIETY HONORS-NIGHT DINNER

More than 300 members and guests of the American Rocket Society assembled on Thursday evening in the ballroom of the Hotel McAlpin for the Honors-Night Dinner, the high light of the society's three-day Eighth Annual Meeting held in conjunction with the 1953 ASME Annual Meeting. F. C. Durant, III, retiring ARS president, presided over the occasion. Lt. Gen. Donald L. Putt, U. S. Air Force, Commander, Air Research and Development Command, was the guest speaker.

Mr. Durant began the honors ceremonies by introducing the guests seated on the dais, among whom were: F. S. Blackall, jr., retiring ASME president; Mrs. Esther Goddard, widow of Dr. Robert H. Goddard, pioneer in rocket research; G. Edward Pendray, Fellow ARS and member ASME; Wernher von Braun, Guided Missiles Development Group, Redstone Arsenal; and

PROF. DONALD S. CLARK, *right*, CONGRTAULATES MERL BAKER, *left*, PI TAU SIGMA MEDALIST, AND THOMAS M. LUMLY, *center*, WINNER OF THE RICHARDS MEMORIAL AWARD

AT THE ANNUAL BANQUET

(*Left to right*, Dean J. Stanley Morehouse, R. M. Van Duzer, Jr., chairman, Board on Honors, and Lionel J. Cucullu, Director at Large.)

S. Paul Johnston, director of the Institute of the Aeronautical Sciences.

After extending greetings to the ARS past-presidents in the audience, Mr. Durant then introduced the members recently elected to the Fellow grade of ARS membership. The men so honored for their distinguished contributions to the advancement of rocket science and their service to the society were: Luigi Crocco, Goddard Professor of Jet Propulsion, Guggenheim Jet Propulsion Center, Princeton University; J. W. Mullen, president of Experiment, Inc., Richmond, Va.; William Smith, head of the Rocket Division, Bell Aircraft Company; R. E. Gibson, Applied Physics Laboratory, Silver Spring, Md.; and C. C. Furnas, Cornell Aeronautical Laboratory, Buffalo, N. Y.

The following awards were presented:

Dr. R. W. Porter of the General Electric Company, presented the 1953 Student Award to Alfred D. Goldenberg, Palm Springs, Calif., for his tireless enthusiasm in founding and directing a student organization to stimulate interest in rocket science. Sheldon Deritchin received the award in Mr. Goldenberg's absence.

The G. Edward Pendray Award was given to Dr. H. S. Tsien, Guggenheim Jet Propulsion Center, California Institute of Technology, for his technical contributions to the field of jet propulsion since 1938, for his adaptation of physical science to engineering use, and for his mighty contributions to the jet-propulsion literature. In Dr. Tsien's absence, Dr. S. S. Penner, California Institute of Technology, accepted the award. Dr. Pendray made the presentation.

C. E. Bartley, director of the Grand Central Aircraft Company, Glendale, Calif., received from Dr. Hickman the C. N. Hickman Award for his many contributions to the field of solid propellants.

GENERAL PUTT TALKS ON ROCKET POWER

General Donald L. Putt, the featured speaker, in discussing "Long-Range Applications of Rocket Power," reviewed the long history of rocket power. He described how the earliest rockets, dating back to the thirteenth and fourteenth centuries, had a fairly peaceful start, being used mainly by the Chinese and Arabs for signaling and illumination. It was not until the late 1700's that the British recognized the military possibilities of the rocket and established their famed Rocket Corps. By the end of the nineteenth century fiction writers and scientists alike began to envision the rocket as a means of conquering space. But it was not until World War II that rocket power came of age, and since then it has made greater strides than in the entire preceding seven centuries.

At the present time, General Putt said, the most promising and widely publicized application of rocket power is, of course, for the propulsion of guided missiles. One aspect of the rocket-powered missiles not fully appreciated, he pointed out, is the important contributions these missiles have already made to meteorology, astronomy, biology, and many other sciences. While all work in this connection has been under military sponsorship, it clearly points to the day, he said, when the rocket missile will find its principal applications in peaceful endeavors.

However, General Putt remarked, such applications are in the future and there are still many problems to be solved in spite of recent improvements in fuels, materials, designs of power plants and vehicles, and improvements in guidance control of rockets and pilotless aircraft.

The possible applications of rocket power could be enumerated indefinitely, the speaker continued. We could dream of man-made satellites and of rockets to the moon, but their realization lies so far ahead that they are still beyond the scope of informative discussion by the military engineer. And there may be applications of which we cannot even imagine, applications so revolutionary and fantastic that no human brain has even conceived of them.

Let us hope, General Putt concluded, that whatever undreamed-of applications of rocket power may be found in the future will serve the prosperity and civilization of a free world at peace.

TEXTILE ENGINEERING LUNCHEON

Speaking on the subject, "New Trends in Textile Education," at the Textile Engineering Luncheon on Friday, Herman A. Dickert, director, A. French Textile School, Georgia Institute of Technology, Atlanta, Ga., discussed the changes which have

taken place in the textile industry and how they have affected textile education.

Tremendous progress has been made in the past few years in textile mills, he told his audience.

There has also been a change in leadership in the textile industry during the past few years. Since World War I the textile industry has grown from a family enterprise into a big business. We have had quite a change in mill management. Management now thinks more in terms of trained men than they used to.

The rapid growth of the industry as well as technological development has made new types of men necessary. The textile industry today has to have such men as technicians, sales people, and engineers. Prior to World War I it was considered a waste of money to hire these types of men. It was difficult for a college-trained man to work his way up in the textile industry. Today management is convinced that college-trained men are an asset to their business. The textile business is no longer a one-man proposition but a teamwork job.

In discussing some of the differences between the old and the new methods of training, Professor Dickert said that today broad fundamental training is being stressed rather than the specific vocational method of training that was once taught. The early schools were directed more toward the development of specialized interests. We are not thinking so much in that direction now as we are in the direction of potential leaders. We are interested in training men who have a broad background—men who can go a little bit further a little bit faster. Men with this broad training can develop their specialized interests afterward.

It is important that we teach students at a college level and not at a vocational level, he said. Textile men today must have a background of textile engineering, science, and management.

At Georgia Tech, said Professor Dickert, we try to turn out men who, given the fundamentals, are capable of absorbing some of the experience. We set it up on the basis of three options: The textile manufacturing option, the textile engineering option, and the textile chemistry and dyeing option. We try to give students the necessary background to tackle any particular phase of industry into which they want to go.

We are becoming more conscious of research in schools today. This is partly because of the development of new fibers. Business is looking more and more to research to increase their prestige. As a result, schools are now trying to train men with a better appreciation of research. Textile schools make every effort to keep up with changes and needs in industry.

We need teachers, he said, who have at least an appreciation of the practical. We have to get it across to the students that they are going into the textile business to make money. Students also have to have a good knowledge of management practice to be able to control production, sales, and finance. Students have to be trained and be competent in creative effort because it is needed in business. It is extremely important that they be trained in human relations—trained to handle people.

The answer to the problem of training textile men is no different from forty years ago, said Professor Dickert; only the approach is different. Remember that in the textile business there is no such thing as smooth curves as far as fortunes of industry are concerned. Progress is uneven. We must try to keep that fact before us in setting up a curriculum. For the present, he said, we hope that industry approves of our product and approves of the direction in which we are going.

Lindsay Dexter, Jun. ASME, assistant treasurer, Pepperell Manufacturing Co., Boston, Mass., presided at the luncheon.

PETROLEUM LUNCHEON

The relationship of the ASME Petroleum Division to other technical societies and to the petroleum industry itself was discussed by R. J. S. Pigott, past-president and Fellow ASME, the principal speaker at the Petroleum Luncheon on Friday. The petroleum industry, Mr. Pigott said, has grown terrifically in both size and importance during the past 25 years. Its technical field embraces the work of the chemist, geophysicist, geologist, and the engineer. Consequently, he said, a fair number of technical societies have a legitimate interest in the industry—these interests frequently are overlapping and give rise to rather serious rivalries between societies.

PROGRAM OF ASME PETROLEUM DIVISION

The early experience of the Petroleum Division illustrated this situation and, as a result, the Division lost ground to more specialized societies, finally perishing of anemia.

Sometime later, the societies that had drawn interest away from the ASME Petroleum Division apparently also failed to satisfy the needs of the group, and a return drift began. As a result, after a year or two of development, the Petroleum Division started off on a new lease of life. During this interregnum, Mr. Pigott suggested in outline a policy that seems to have been followed with success. This policy, he said, was aimed at avoiding the earlier conflicts in the field with other societies. In short, the ASME Petroleum Division should center its attention as strictly as possible on the mechanical side of petroleum problems and leave the commercial and economic aspects to other societies that had a major stake in the broad problems. And, where an overlap of interests could not be avoided, ASME should develop joint action.

One field, for example, is the production of crude oil—drilling, gas-lift, pumping by rod lines, individual rod and hydraulic pumps, transportation by pipe line, fluid measurement, and and instrumentation for bottom-hole sampling, pressure, temperature, and gas content. All have a strong mechanical-engineering interest, from the design side. In addition, there is a field of wide extent covering the commercial operation and economics of great importance to the American Petroleum Institute and, to a lesser degree, where materials or corrosion are problems, to the American Society for Testing Materials and the chemists. We can keep off the grounds of other teams, he said, by sticking to the mechanical-design side of these problems, in which we are undoubtedly the best qualified. This has been proved by the drift back toward ASME—the petroleum group wanted better designing and were not getting it elsewhere.

Looking at refined products—such subjects as gasoline, diesel, and other fuel oils are interesting to the Petroleum Division, particularly on design of carburetors, injection systems, and combustion chambers.

Joint action is a very useful tool in cases where the interests of two or more societies cross. Some years ago, sharp-edged orifice coefficients were standardized by joint action between ASME and the American Gas Association.

In the past two or three years, a joint volunteer test code (for performance and accuracy) has been developed between ASME and API. Right now API and ASME are getting together on a single Pressure Vessel Code (distinct from the Boiler Code), after a few years of argument. This joint action stops argument, and often real fights, by pooling the interest and skill of all parties concerned.

PRESENTATION OF CERTIFICATES

As part of the luncheon program, O. L. Lewis of C. F. Braun & Co., Alhambra, Calif., who presided, awarded certificates of appreciation to the following retiring committee chairmen of

the Petroleum Division: J. S. Rearick, M. W. Kellogg Company of the Refining Committee; T. L. White, Commercial Shearing and Stamping Company, of the Manufacturers Committee; and L. S. Wrightsman, Humble Pipe Line Company, for services on Local Arrangements. Mr. Lewis also announced that the following chairmen, who were not present, will receive certificates: L. Ballard, Tide Water Associated Oil Company, of the Applications Committee; C. C. Keane, Great Lakes Pipe Line Company, of the Transportation Committee; A. Foster, Petroleum Engineer Publishing Company, of the Press Committee; and H. E. Degler, Marley Company, as Publicity Secretary.

Dr. E. N. Kemler, retiring chairman of the Petroleum Division, also was unable to be present. A certificate of appreciation will be mailed to him.

WOOD INDUSTRIES LUNCHEON

"Development of Industrial Standards" was the subject of the speech by Cyril Ainsworth, Technical Director of the American Standards Association, at the Wood Industries Luncheon, Friday, December 4.

CYRIL AINSWORTH SPEAKS ON INDUSTRIAL STANDARDS

Mr. Ainsworth said that in this country, standardization begins in company activities. Our mass production is based on company standards, and no other country in the world has so many of them. Compared to other countries, however, we have very few national standards.

Company standards usually are not enough; industry-wide standards are needed. There is so much overlapping between industries that national standards must be developed. Finally, there is international standardization. This, he said, is the most difficult phase of all, but it is being developed. It involves co-operation between industries, groups of industries, and countries.

Standards are developed by co-operation, Mr. Ainsworth asserted. There must be a definite desire by an industry to change a situation. Sometimes this desire must be developed where the need for a standard is great. There must always be a willingness to co-operate among the companies in an industry. The ASA procedures, as they have been worked out over the past 35 years, provide a means whereby groups can co-operate. Usually standardization is started by a national group of companies in one industry. Small groups may get together, work out a needed standard, and send it through a national organization like the ASA. Sometimes a branch of an industry will start a standard. Occasionally one company will develop a standard which it feels will benefit the entire industry.

It is, of course, easiest to start standardizing a new industry, such as the electronics industry, he stated, where much work is still in the planning stage. Old and well-developed industries have a harder time because habits have grown and change is more serious.

The major standardization work in this country, Mr. Ainsworth said, grew out of the experiences of the first world war. From a beginning of eight national groups and government agencies, the ASA has grown and is today composed of 110 national societies, trade associations, and government agencies. The organization's main objective is to help provide the background for the co-operation and co-ordination that is the basis of all standardization.

REPORTS OF WOOD INDUSTRIES DIVISION PRESENTED

At the luncheon of the Wood Industries Division a report was submitted by Thomas D. Perry, chairman of the Committee on Wood Cutting and Woodworking Equipment, on the work done on the Standardization of Carbide Tips for Woodworking Saws and Planer Knives. The secretary of the Wood Industries Division, Mr. Wilkins, read his report of the year's work and presented the chairman of the Division, Norman C. Bye, with a Certificate of Appreciation. Mr. Bye presided at the luncheon.

RECORD TECHNICAL PROGRAM OFFERED

This year's Annual Meeting technical program of some 100 sessions, at which 289 papers were presented, was the largest ever offered by ASME. In addition, the American Rocket Society, an affiliate of ASME, held its annual meeting jointly with ASME. The ARS scheduled eight technical sessions. The Society for Experimental Stress Analysis also contributed a program of four technical sessions. (See pages 100–103 for a list of available preprints of the technical papers.)

To give some idea of the scope covered by the technical program, some of the high points of the meeting follow.

FREQUENCY-RESPONSE SYMPOSIUM

The first symposium devoted to the subject of frequency response of feedback control systems created wide interest as evidenced by the overflow audience of more than 300 attending the sessions, which extended over two days and included the presentation of sixteen papers on the subject.

The papers were on a high technical level, and the symposium was given a distinct international flavor by the presence of nine European speakers from England, France, Germany, Holland, and Sweden. Abstracts from all the papers are given elsewhere. A number of instruments used for frequency-response tests in this country were on demonstration throughout the symposium.

INDUSTRIAL ATOMIC POWER

Of great interest to mechanical engineers was the panel on "Progress Toward Industrial Atomic Power," sponsored by the Nuclear Energy Applications Committee. The various types of reactors, major problems, and the development work under way were described and it was pointed out that with industrial participation the program is well balanced. A comparison of the economics of nuclear power with conventional steam and hydro power was presented. Estimates of probable effects of engineering and construction tasks of a nuclear power station on the time and cost to accomplish commercial operation were also given.

POWER

This year's Power Division program included a wide range of material and covered such subjects as land and marine steam power-plant practice, a panel on manpower and other factors affecting operating costs in steam-generating stations, design descriptions and operating experience of controlled-circulation boilers, a symposium on design for and experience with outdoor power plants, and a progress report of an experimental superheater for steam after 12,000 hr of operation at 2000 psi and 1250 F.

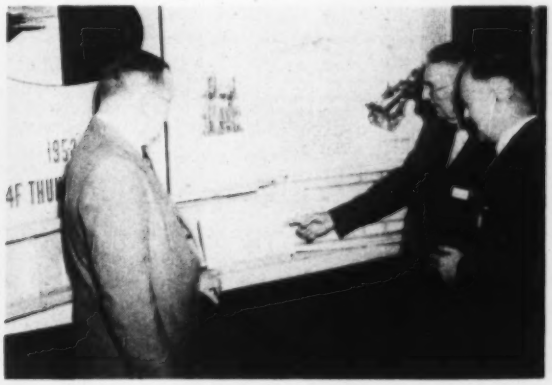
GAS-TURBINE POWER

Gas-Turbine Power Division papers included an outline of a program to continue the Navy's progress on gas turbines for ships; a description of a mobile 4500-kw gas-turbine power plant, now under construction, to provide emergency power for Navy shore installations; a novel cooling method for gas turbines whereby water is sprayed directly into the rotor blades; and a cycle analysis of the free-piston and turbine compound engine.

ENJOYING CHAT AFTER APPLIED MECHANICS DINNER ARE (*left to right*) MARTIN GOLAND, EDITOR, "APPLIED MECHANICS REVIEWS," J. M. LESSELLS, EDITOR, "JOURNAL OF APPLIED MECHANICS;" AND S. I. JUHASZ, AMR EXECUTIVE EDITOR

DANA YOUNG (*center*), OUTGOING CHAIRMAN OF THE APPLIED MECHANICS DIVISION, ACCEPTS CERTIFICATE OF APPRECIATION FROM N. M. NEWMARK (*right*) AS DR. RALPH MORGAN (*left*) PRINCIPAL SPEAKER AT THE APPLIED MECHANICS DINNER, LOOKS ON

MEMBERS OF THE U. S. AIR FORCE AND U. S. NAVY SHOW INTEREST IN TRANSONIC PROPELLER BLADE, DESIGNED BY CURTISS-WRIGHT, AERONAUTICAL DIVISION, FOR USE WITH 10,000 TO 12,000-HP TURBOPROP ENGINES



R. B. LEA (*center*) POINTS OUT INTERESTING FACTS OF AVIATION EXHIBIT TO F. T. HAGUE (*left*) AND F. S. BLACKALL, JR. (*right*); THE EXHIBIT COMMEMORATES THE FIFTIETH ANNIVERSARY OF POWERED FLIGHT

AT THE PETROLEUM LUNCHEON, O. L. LEWIS (*extreme right*) PRESENTS CERTIFICATES OF APPRECIATION TO PETROLEUM DIVISION COMMITTEE CHAIRMEN (*left to right*) J. S. REARICK, L. S. WRIGHTSMAN, AND T. L WHITE

SHOWN AT THE PETROLEUM LUNCHEON SPEAKERS' TABLE ARE (*left to right*) E. W. JACOBSON; R. J. S. PIGOTT, A PAST-PRESIDENT AND FELLOW ASME, AND PRINCIPAL SPEAKER AT THE LUNCHEON O. L. LEWIS, WHO PRESIDED, AND P. E. FRANK

FUELS

Concerning the topic, the future for fuels, the Fuels Division covered future energy supplies and consumption; underground gasification of coal at Gorgas, Ala.; and the operation and design features of two coal-gasification plants using pulverized coal, steam, and oxygen. Other subjects included solving present-day fuel problems, handling combustion waste products, and a panel on residual fuel oil for gas turbines.

AUTOMATION

That mechanical engineers are preparing for the advent of the automatic age was characterized by the scheduling of a symposium on "The Problems of Management in the Automatic-Factory Age," covering the problems of engineering, economics, and organization. The automatic factory was defined as consisting of one or more continuous product lines completely automatic, from raw-material ingestion to finished-product shipment, controlled and monitored by computers. Human effort and decision in production would be confined to the programming of line maintenance level. It was pointed out that under automation, management functions will be modified in many phases. As an example, for advanced planning, a forecasting computer was suggested, which, acting on information inputs concerning markets, raw materials, personnel, equipment and maintenance costs, and other known variables, will help predict the company's response to a contemplated course of action, or one already in effect. Other changes predicted include accounting, design of production-line units, and personnel with more technical background.

AVIATION

The fifth annual "air-cargo days" again received much attention this year. Panels and symposiums covered lift air-cargo needs—ground handling, packaging, and aircraft design; air-cargo interchange and handling; helicopters as cargo carriers; and a discussion of the Wright turbocompound engine that will power a number of the passenger and freight planes now under construction.

At the second annual heavy-press program the operation of the largest extrusion press in the United States at the Alcoa plant in Lafayette, Ind., was discussed. In addition, subjects on straightening extruded shapes, recent designs of straightening and stretching machines, and recent developments in extrusion were covered.

AIR POLLUTION

A symposium on Air Pollution Control with a theme of "Air Pollution—A Universal Problem," created wide interest. The dramatic story of the London smog of 1952 with its record toll of over 4000 lives was told. Air samples taken during the smog showed levels of smoke and sulphur dioxide up to 10 times the normal for that time of year. Mortality data disclosed a distinct day-to-day parallelism between deaths and pollution concentrations. The pattern of sulphur-dioxide pollution was deduced indirectly.

The story of the effort to control the air-pollution problem in New York City was related, emphasizing the isolated but relatively important gains which may be made by such changes as smaller taxicabs with resultant lower consumption of gasoline, elimination or major change in the procedures governing the use of flue-fed incinerators, and of the important expenditures made by local industry for controls, particularly in the utility field.

The international flavor of the meeting was furthered by the detailed story of the work being done in Canada by a number of communities. An analytical description of the municipal by-laws governing air pollution and a number of interesting examples of the effects of contamination were presented.

The Los Angeles story, illustrated by effective colored slides on the diurnal development of smog as one part of the principal investigation of the problem, offered a running account of the day-to-day investigation and also a description of the development of special methods and techniques necessary for this unusual problem.

VARIETY OF OTHER TECHNICAL MATERIAL

A wealth of other technical material was presented during the meeting—to great to review in this limited space—but briefly the program included symposiums and panel discussions on physical properties, measurement of small flow, pulsation measurement and control, evaluation of experimental uncertainty and design of engineering experiments, technical aspects of the hotbox problem, railway steel wheels, and attachment of tubes to tube sheets. In addition, papers covered new developments and research in applied mechanics, hydraulics, rubber and plastics, education, low-temperature flue gas, metals engineering, machine design, production engineering, metal processing, safety, boiler-feedwater studies, petroleum, textile engineering, wood industries, and process industries.

Other societies and organizations contributing to the vast program included the Society of Automotive Engineers, the Institute of the Aeronautical Sciences, National Security Industrial Association, Transport Air Groups, Society of Naval Architects and Marine Engineers, American Society for Testing Materials, American Society of Lubricating Engineers, American Institute of Electrical Engineers, and the Society for Experimental Stress Analysis.

Pages 100–103 contain a list of preprints that were made available at the meeting. The list is arranged according to Divisions. In the ASME Technical Digest of this issue, 60 digests of Annual Meeting preprints appear. Digests of any remaining Annual Meeting preprints will be published in the ASME Technical Digest Section of forthcoming issues of MECHANICAL ENGINEERING.

AMERICAN ROCKET SOCIETY

The technical program of the American Rocket Society covered rocket and turbine testing, thermodynamics, fluid flow, heat transfer, combustion studies, liquid properties, handling, and analytical procedures. A feature of the meeting was the symposium on space flight. Subjects covered included how to shield space ships from radiation, the potential of new alloys in space flight, the economics of stage recovery in satellite operations, and many others.

INSPECTION TRIPS

Many interesting inspection trips were scheduled during Annual Meeting week. On Tuesday, December 1, ASME members and guests enjoyed an interesting visit to the Bush Terminal Buildings Company, Brooklyn, N. Y. The tour included a visit to the powerhouse rectifying station, a trip around the plant, and an inspection of some of the buildings and method of operation.

Also on Tuesday members and guests visited the First International Machine Tool Exposition in Brooklyn, N. Y., where machines of tomorrow were on display today. Stretching an entire block, this exhibit displayed nearly 1000 of the latest machine tools from seven countries—United States, Italy, France, Germany, Japan, Switzerland, and Great Britain, all under power and available for actual demonstration.

One of the most interesting inspections was scheduled to the S. S. *United States*. Through an unfortunate combination

of circumstances, the U. S. Coast Guard called for an official inspection trip just as members and guests of the ASME were waiting to start their tour. The trip was of necessity canceled, much to the chagrin of the Committee in charge.

On Wedensday, December 2, a most interesting trip was made to the Pepsi-Cola Company, East River Plant, Metropolitan Bottling Co., Inc., Long Island City, N. Y. The New York Operations Bottling plant is the largest bottling plant in the world under one roof.

On Thursday, December 3, a tour was made to the Consolidated Edison Company of New York, Inc., Astoria Electric Station, Astoria, L. I. This is the first new station of the Consolidated Edison System in twenty-five years, which includes high-pressure reheat units with pressurized boilers.

The last trip of the Meeting, on December 3, also, was to the International Business Machines Corporation—IBM Electronic Data Processing Machines—New York, N. Y A film "Piercing the Unknown" was shown, followed by a visit to the Electronic Data Processing Machines. IBM designed these machines principally for the use of scientists and engineers engaged in vital defense projects—the most powerful and productive computer ever made available in quantity.

COLLEGE REUNIONS

This year 15 colleges and universities took advantage of the gathering of mechanical engineers at the Annual Meeting and scheduled reunions for former graduates. The schools held luncheon and dinner meetings all over the city. The following is a list of the schools which held reunions: University of California, Carnegie Institute of Technology, The Cooper Union, Cornell University, Georgia Institute of Technology, Johns Hopkins University, University of Michigan, University of Missouri, Oregon State College, Pratt Institute, Purdue University, Rensselaer Polytechnic Institute, Stevens Institute of Technology, Tufts College, and Worcester Polytechnic Institute.

COMMITTEES IN CHARGE

Meetings of The American Society of Mechanical Engineers come under the general supervision of the Meetings Committee. The technical program is provided by the Society's professional divisions and technical committees. Other features are planned and supervised by committees organized within the host Section—in this case the Metropolitan Section. In grateful acknowledgment of the many committees whose efforts contributed so substantially to the success of the 1953 Annual Meeting their personnel is listed in what follows:

Meetings Committee: J. W. Barker, chairman; Jess H. Davis, Roland W. Flynn, Glenn R. Fryling, J. K. Louden, Thomas A. Marshall, Jr., W. M. Morley, and C. W. Parsons.

Board of Honors: Robert M. VanDuzer, Jr., chairman; Lionel J. Cucullu, Ernest L. Hopping, Eugene W. O'Brien, Warner Seely, and Harry R. Wescott.

Medals Committee: Robert M. VanDuzer, Jr., chairman; Theodore H. Beard, Eugene Caldwell, Lionel J. Cucullu, Newton C. Ebaugh, Burnham Finney, Arthur E. Grunert, Frank M. Gunby, H. Drake Harkins, Ernest L. Hopping, Alfred Iddles, Leon T. Mart, J. Stanley Morehouse, Lester F. Nenninger, Eugene W. O'Brien, Frank Prouty, Warner Seely, C. Richard Soderberg, Harry R. Wescott, and Gerald V. Williamson.

Annual Banquet Committee: James T. Costigan, chairman; E. S. Bance, J. T. Robinson, U. A. Rothermel, and E. S. Rowell.

Senior Ushers: John T. Jackman, Adolph Ehbrecht, Frank W. Farrelly, R. O. Bailey, and E. S. Bance.

Junior Ushers: R. S. Chase, F. Danker, J. B. Field, A. D. Halporn, Jr., J. J. Happell, D. G. Hoyt, D. H. Larsen, A. Santilli, H. J. Scagnelli, and R. W. Schubert.

Committee on Women's Activities: Mrs. Charles M. Hickox, honorary chairman; Mrs. U. A. Rothermel, general chairman; Mrs. Crosby Field, general vice-chairman; Mrs. Robert Cockrell, Mrs. John C. Gibb, Mrs. Clarence H. Kent, Mrs. H. R. Kessler, Mrs. John Hochuli, Mrs. Robert B. Skinner, and Mrs. Norman Wyckoff.

Committee on Student Aides: Honorary Chairmen of Metropolitan Colleges; Fred P. Burns, Joel E. Crouch, C. R. G. Dougherty, Allen A. Kurtis, Edward Miller, Walter J. Norton, Gordon B. McKay, Fred H. Posser, Kenneth E. Quier, W. H. Ruten, and G. P. Stone.

Inspection Trips Committee: H. C. R. Carlson, Sabin Crocker, M. O. England, R. W. Flynn, and A. T. Kniffen.

MAIN PLAZA AND CATHEDRAL, MEXICO CITY

(See pages 113-114 on ASME International Meeting in March, 1954.)

1953 ASME ANNUAL MEETING PREPRINTS

Pamphlet copies of the following ASME Annual Meeting Papers are available from ASME Order Department, 29 West 39th Street, New York 18, N. Y.
See page 42 for details

Paper No.	*Title and Author*
	AIR-POLLUTION CONTROLS
53—A-138	Air-Pollution Control in Canada, by E. A. ALLCUT
53—A-161	Air Pollution in a London Smog, by E. T. WILKINS
53—A-162	Air-Pollution Control in New York City, by LEONARD GREENBURG
53—A-163	Air Pollution in Los Angeles, by P. L. MAGILL and F. E. LITTMAN
	APPLIED MECHANICS
53—A-1	Dynamic Behavior of Reinforced Cylindrical Shells in a Vacuum and in a Fluid, by M. C. JUNGER
53—A-2	Stress Concentrations Around a Small Spherical or Spheroidal Inclusion on the Axis of a Circular Cylinder in Torsion, by SISIR CHANDRA DAS
53—A-3	On Application of a Quasi-Static Variational Principle to a System With Damping, by MORRIS MORDUCHOW
53—A-4	Stresses in a Metal Tube Under Both High Radial Temperature Variation and Internal Pressure, by CHIEH CHIEN CHANG and WEN-HUA CHU
53—A-6	Flexibility of Piping Systems Supported by Equally Spaced Rigid Hangers, by J. E. BROCK
53—A-7	Bending of Circular and Ring-Shaped Plates on an Elastic Foundation, by HERBERT REISMANN
53—A-8	Stress Concentration Due to a Hemispherical Pit at a Free Surface, by R. A. EUBANKS
53—A-9	The Stepped Thrust Bearing—A Solution by Relaxation Methods, by C. F. KETTLEBOROUGH
53—A-10	On the Strain Energy of Shells, by H. L. LANGHAAR and D. R. CARVER
53—A-27	A Theory of Torsion Bending for Multicell Beams, by S. U. BENSCOTER
53—A-28	Analysis of Plastic Deformation in a Steel Cylinder Striking a Rigid Target, by E. H. LEE and S. J. TUPPER
53—A-29	Plastic Flow in a Rectangularly Notched Bar Subjected to Tension, by E. H. LEE
53—A-30	Stress Concentration Due to Elliptical Holes in Orthotropic Plates, by H. D. CONWAY
53—A-31	Contact of Elastic Spheres Under an Oscillating Torsional Couple, by H. DERESIEWICZ
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COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Light-Alloy Forging

COMMENT BY J. R. DOUSLIN[1]

This paper[2] deserves the closest study and attention of aircraft and forging engineers everywhere. The problems of large-forging production as seen after a year's experience in operation of the 15-000-metric-ton press are essentially the same as those encountered in the writer's experience after several years' operation of the 18,000-ton Mesta press at North Grafton, Mass. Having worked with these problems for a greater length of time, we are hopeful that the following discussion may serve to throw added light on some of them.

The effect of die and press deflection on forging tolerances and die life is a case in point. The observed deflection is composed of two parts; (1) a beam-type deflection which is inherently a function of the rigidity of the press platens, and (2) a compressive deflection which is a function of the unit die pressures as related to the modulus of elasticity of the die material.

The beam-type deflection is an effect which is difficult for the forging engineer to cope with. Suggestions have been made that the die designer build a compensating bow into the die. As yet, no really practical way has been devised to accomplish this. The best solution appears to lie in designing the required rigidity into the press, and it is encouraging to note that this factor has been given major attention on all the new large-press designs.

The second type of deflection occurs because unit pressures at the center of a forging (assuming no cutouts for pressure relief) are greater than at the edge. The greater the distance from center to nearest free edge the greater the unit pressure differential, and the greater the difference in compressive deflection. Die design, forging design, and manufacturing practices do play an important part in determining how great these pressure differentials will be. The factors, which the author mentions as helpful in reducing average unit forging pressures, are the same factors which will reduce pressure differentials across the die face. Thus by studying and controlling these factors we stand to gain both ways.

The aircraft designer can make a significant contribution to the problem of reducing unit pressures by observing the good practices mentioned by the author. And yet, so often, the good practices run counter to the designer's needs from an engineering standpoint. For this and other reasons it is the writer's opinion that by far the greatest possibilities for effective action lie in the realm of forging manufacture. Proper die temperatures, dwell times, and most important of all, effective die lubrication, offer tremendous possibilities. We have had some little success along these lines in the past year, and the results are encouraging.

Naturally, we have accumulated more experience on die life than has yet been possible on the 15,000-ton press. We have had some sad experiences and also some very good ones. Our evaluation coincides closely with the author's. (1) We feel that for large, deep-cavity dies more attention must be given to providing a strong and tough structure in the center of the die, not just on the impression face as has been common practice with hammer dies. (2) A press with poor deflection characteristics assuredly will have a detrimental effect on the die life. (3) Like any large mass of metal, large dies must be handled tenderly as regards any thermal treatment. Heating to operating temperature must be done slowly and uniformly, preferably in a furnace designed for the purpose. (4) While it might seem that press service would be less rugged than hammer service, in our experience we find it wise to provide for somewhat greater bottom and side-wall thickness to carry adequately the sustained loads encountered in press operation, where time as well as load magnitude must be taken into account.

Mr. Favre comments on the difficulty of providing "spare" or "reserve" die equipment for large forgings, pointing out that, if the dies are failing, the first concern must be to eliminate the cause. While granting the truth of this view, we believe that the problem should be analyzed without regard to size. If expected quantities and importance of uninterrupted delivery would dictate spare dies on a small forging, then the same provision must be made regardless of size.

As regards die sinking the author is correct in pointing out that special problems are presented. Our answer to these problems is increased use of duplicating techniques and equipment. Such equipment already has been designed and is actively on the market in sizes large enough to provide for the sinking of any die that we can forsee for some time to come. Our experience to date with these methods has been excellent, and the problems of accuracy introduced by duplicating have in large measure been overcome. We also feel that such equipment, properly used, is appreciably faster and will reduce tooling-up time substantially.

In so far as tolerances are concerned, press methods do offer some unique advantages over the hammer in terms of draft angles, uniformity of length and width, and mismatch control. Conversely, the hammer offers some advantages such as the opportunity for repeated lubrication as necessary between blows, and the ability to strike an extra blow or two, as necessary, for complete fill of the die cavity. Problems of shrinkage, distortion, and residual stress after heat-treatment are common to both hammer and press forgings.

Perhaps our longer experience permits us to be more optimistic than the author regarding straightness tolerances. We feel that most forgings, if necessary, and of course, at added expense, can be straightened to within ±0.030 in. If most large forgings are going to require this degree of straightness, adequate provision for equipment will have to be made to perform the straightening operations. It is possible also that die-quenching techniques will be applicable in some cases.

This discussion would not be complete without mentioning our thoughts on thin webs and the concurrent problem of small or zero draft angles. We are not ready to agree that webs under 0.140 in. and zero draft angles are unfeasible to produce by forging. In fact, such shapes have been produced by us ex-

[1] Superintendent, Grafton Plant, Wyman Gordon Company, Worcester, Mass.

[2] "Light-Alloy Forging—Design and Production Problems," by A. E. Favre, MECHANICAL ENGINEERING, vol. 75, September, 1953, pp. 693–697 and 718.

perimentally, as demonstrated in the widely publicized Lockheed wing-panel forging. What does concern us is the mistaken impression sometimes held that such features are a practical cure-all available in production forgings today.

COMMENT BY FRED C. PIPHER[3]

Since the aircraft industry at this time appears to be the principal user of the products of the heavy presses, the writer would like to discuss this paper from this viewpoint and to present the approach taken by his company to obtain an interim solution to the many unanswered problems we face with every effort to design large forgings for production on the heavy presses.

In every component of an airframe structure we attempt to achieve maximum structural integrity with minimum weight compatible with the ease and cost of production. The advantages of single-unit structures, such as large forgings, wide profile extrusions, and large cast elements over our present methods of building up a structure from bits and pieces, have been stated time and again whenever the subject of the heavy presses has been discussed. In our efforts to design single-unit structures, particularly forgings, we encounter many problems relative to their design. Today, some of these questions and problems which arise have been answered in a general way; however, when the chips are down, we must have specific answers—not generalities.

The author points out the necessity for closer co-operation between the designer and the producer. This co-operation is indeed a prerequisite to the development of a sound forging design. However, in many cases schedule commitments do not permit personal contact on these designs to the degree that we would like. In the case of large-press forgings, so little experience is available and so little information published on design that, in many cases, we must rely on our own judgment to prepare the initial proposal. It can be said, without reservation, that we have been very pleased with the co-operative attitude of the producers and the results of personal contacts with them.

In the early design stage of every large-press forging, a proposal is made and compared against the possible alternate methods of producing a comparable structure. Strength, weight, production and assembly costs, procurement time span, total production quantities, and production rates are all considered. The decision on the final design is generally a compromise permitting manufacture by the most economical method available.

During the past several years the design of new aircraft has progressed to the point where large single-unit structures are finding wide application. We have considered large forgings for many of these applications; however, owing to the lack of available equipment to produce these parts, we have been compelled to resort to the machining of these structures from hand-forged billets, plate stock, or have continued with our past practice of designing a built-up structure. In order to meet our production schedules, we have had to improve our present machining techniques and to develop or, at least, assist in the development of new and improved machine tools to permit economical fabrication of these structures. As the result of this development, large forged members must now compete with the alternate method of producing the same component by these new and improved machining techniques.

We have found, in our cost and manufacturing analysis of such components, that it is not economical for us to set up and machine a forging to the final desired configuration merely to remove excess material. Invariably, it is less expensive for us to finish-machine a part starting from a hand-forged billet rather than to start with a rough forging and then machine the forging practically 100 per cent. This should not be surprising when one considers that the machine tools and fixtures required are practically the same for both designs and about the only difference in machining time is in the original rough-cutting operations. The cost of the rough forging, then, must be cheaper than the cost of these rough-machining operations. Our experience has been that this is not the case. Large forgings, although generous in design proportions, have been quoted as high as $7 and $8 per lb. If a forging, at this price, must be machined before it can be used, generally it cannot compete with the same part machined from billet.

The author discusses the factors affecting forging proportions and indicates that draft angles can be reduced, thinner webs can be achieved, allowances and forging tolerances can be reduced, and use made of "in-process" machining operations to assist in obtaining the final desired product. We are encouraged by such thinking and, during the past year, considerable progress has been made toward obtaining such improved forging proportions. We now have acceptable forging designs with considerably thinner webs than present published design data would indicate, higher and thinner ribs with 5-deg draft and in some cases 3 deg and closer dimensional tolerances. Not all of these desirable features have been incorporated into each forging. Each design has been discussed with the producers and the design represents the best thinking to date, all factors considered.

We have several designs which reflect the progressive thinking of the forging producers such as an engine-mount forging which is approximately 70 in. long, with an approximate plan area of 350 sq in., and in which we incorporated relatively high thin ribs with a 0.120-in-thick web. This thin web was particularly important to us to avoid the machine warpage which would occur if we were forced to machine one side of a thick web to the final thickness. To achieve this design we increased fillet radii and were fortunate in being able to provide small punch-out areas which assisted in reducing the unit pressures required. Larger radii were incorporated to improve the metal flow from the thin web area to the ribs. When this design was submitted initially to the forging producers for comment, a web thickness of 0.250 to 0.375 was requested. By close co-operation with the producers the final web thickness of 0.125 in. was agreed upon.

In the case of a fire-wall forging with a plan area of approximately 850 sq in., the design incorporates high thin ribs with 3-deg draft. The final web thickness of 0.120 in. will be obtained by in-process machining by the forging producer. Similar proportions were designed into three separate forgings, each with a plan area of approximately 1200 sq in. which assembled to make up a large structural component. Again, in this case, as in the case of the firewall, in-process machining will be used to obtain the final web thickness.

Our success in arriving at these designs substantiates the author's comments relative to the necessity for co-operation between the aircraft designers and the producers of these large-press forgings.

We do not intend to stop with the improvements mentioned in forging proportions. A number of designs are being considered today in which we will attempt to attain 1-deg draft angle in some areas where it is required, and in some areas possibly 0 deg draft will be requested. When these designs are a little further along they will be thoroughly and carefully reviewed with the producers. We are confident that what we have obtained to date is only the beginning of what can be obtained in the future.

The design proportions presented by the author are based on hammer opera-

[3] Lockheed Aircraft Corporation, Burbank, Calif.

tion. We firmly believe that with improved forging techniques, improved die materials and die construction, controlled heating and maintenance of die temperatures during the forging operation will permit at least a 50 per cent and possibly 100 per cent improvement over present drop-hammer limitations. We can and must achieve closer dimensional control. As forgings become larger, added weight incurred by the use of the present dimensional tolerances will be prohibitive.

We can agree with the author that forgings with thin webs, thin ribs, and small draft angles will present straightening problems. Hand-straightening methods probably always will be used to some extent for such parts, but methods of die-quenching and restriking in straightening dies should be developed to assist in reducing these problems. Mechanical ejectors not only will have to be used in removing the part from the straightening die, but also in removal from the finish-forging die.

In the airframe industry where weight is of primary importance, the forging producers must realize that we will continue to design large forgings to be made from 75S aluminum alloy rather than the lower-strength materials. In a few cases, because of the type of loading and design considerations, lower-strength 14S material and possibly, in some cases, A51S may be used. However, the majority of applications will require the use of high-strength materials and forging techniques definitely should be established based on the forging characteristics of these materials.

We can agree with the author on the problems encountered in sinking large forging dies. We believe that as we progress and as forging techniques are improved, the present large single-piece die blocks will be inadequate for the production of precision-type forgings. Die sinking, as it is performed today, will be a costly and time-consuming method for producing dies for high, thin-ribbed forgings. Developments of economical methods for producing forging dies should be undertaken. Built-up, segmented, or inserted dies will be an important phase in the production of thin-ribbed, minimum draft forgings. In the design of segmented or inserted-type dies, a high-quality hot-work tool steel can be used, which will permit operation of dies at considerably higher temperatures without fear of die damage. We can hardly expect to machine dies from single-piece forged die blocks without uncovering a lower-quality core material. We can agree that the use of cast dies is also a definite possibility for cost reduction.

With regard to in-process machining, we would like the forging producers to consider this method as one of their tools for producing finished parts. The aircraft industry, in general, does not want the forging producers to supply us with merely a rough-machined forging. There are few forgers who, at some time or another, have not wished that they had a machine tool for rough-machining forged parts between forging operations. This is the type of operation we are considering as in-process machining.

Residual stresses which result in warpage upon machining of large forgings is definitely a problem. We have requested the forging producers to consider in-process machining where severe warpage was anticipated. We believe that they are in a better position to remove the warpage which occurs than we are. They have the straightening facilities and experience. It is part of their business—not ours.

We in the aircraft industry must understand and recognize the effect on forging quality, production, and costs when we demand forgings with 3-deg draft, thin webs, thin ribs, and small fillet radii. The forging producer must understand and recognize the effect on the cost and performance of our product when we are offered a forging on which we must either accept the weight penalty due to large draft angles, thick ribs, large fillet radii, thick webs, and the lack of adequate dimensional control, or on which we must resort to 100 per cent machining to obtain the final product. Only with the closest co-operation between the designer and the producer can each be made aware of the other's problems.

In concluding, the writer would like to commend the author on the contents of his paper. His optimistic attitude is certainly encouraging to us and we believe with this type of thinking we will not encounter unsurmountable problems in the production of large-press forgings.

AUTHOR'S CLOSURE

It is evident from Mr. J. R. Douslin's comment that the thinking and practices arrived at independently by the author's company are closely related.

Spare Die Equipment. We must agree that if requirements warrant the construction of spare die equipment, such spare or reserve equipment should be built. However, most requirements are of such a nature that the anticipated die life usually exceeds such requirements. Even if quantities would justify spare die equipment, caution and an understanding between the forging producer and the aircraft designer should be arrived at, if possible, so that changes in design would not be of such a nature to obsolete the design before the spare equipment could be put into use.

Thin Webs. Reference to the statement that a 0.140-in-thick web represents the optimum in web thickness must be clarified. This is the thinnest web that we have produced to date in a section that is completely boxed in both die halves. Certain forging designs can be produced with thinner webs. Such designs may have webs with punchouts or may have a flat-top die such as an integrally stiffened wing panel. Both our research department and forge shop have embarked on independent programs to determine the feasibility of producing forgings with extremely thin webs.

We are cognizant of all of the problematical statements contained in Mr. Fred C. Pipher's comment. We appreciate especially the fact that Mr. Pipher recognizes the progress which has been made over the past few years. It is the responsibility of the forging producer to make a sincere effort to achieve further goals, to meet the requirements of the aircraft designers, both metallurgically and designwise.

We wish to extend our thanks and appreciation to Messrs. Douslin and Pipher for the time and effort expended in preparing their comments.

A. E. FAVRE.[4]

Atomic Power Plants

COMMENT BY W. L. HARDING[5]

The extensive test program conducted by the Knolls Atomic Power Laboratory has produced a large amount of data. The authors[6] are to be congratulated upon a very able job of condensing this quantity of material and correlating the results.

In the final correlation of shell-side heat-transfer coefficients for liquid metals, it will be noted that in addition to the usual dimensionless Nusselt, Reynolds, and Prandtl moduli, a term representing the ratio of flow area to heating surface has been introduced. According to the exponent of 2 determined by the authors, it appears this ratio has an appreciable effect on the magnitude of the coefficient. It would be desirable if the flow areas and heating surfaces could be tabulated

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[5] Development Department, Combustion Engineering, Inc., New York, N. Y. Mem. ASME.

[6] "Atomic Power Plants," by R. D. Brooks and A. L. Rosenblatt, MECHANICAL ENGINEERING, vol. 75, May, 1953, pp. 363–368.

for the three pieces of equipment used in this correlation, so that the range of this area ratio could be identified. This might serve as a caution in the design of other equipment with ratios far outside this range.

While space limitations did not permit tabulation of the data for all runs used in the correlations, it is believed the value of the paper as a permanent record would be enhanced if it were possible to list for a few typical operating conditions such major items as total heat absorption, liquid-metal and steam flow rates, and inlet and outlet fluid temperatures.

Other experimenters have in some cases found better correlation with the use of a shell-side equivalent diameter or hydraulic diameter, instead of the actual tube diameter. It is understood that this possibility was explored and found not to be helpful in the present instance.

Engineering Management

COMMENT BY KAM SEIDEL[7]

This paper[8] is particularly interesting because it emphasizes an evolution of thinking which has been crystalizing in the minds of engineering and top management. Constructive criticism, particularly during recent years, has been concentrated more and more on the intangibles of organization and management rather than on purely technical problems.

Actually, as the author indicates, the American engineer has never really found it difficult to put his technical knowledge to work. Once the cockiness of the new graduate is replaced by a realistic view of his profession and an earnest desire to do better work, further technical training is accomplished easily. Rarely is it a lack of engineering ability that impedes his advancement.

The weakness of the average engineer is usually his lack of skill in handling the human-relations problem. The formal training which he receives is of little help, and when he emerges into the industrial world, he finds himself surrounded by others who have the same weakness. It is this flaw which, as the author describes it, "can make a good engineer into a lousy manager."

Therefore it becomes the responsibility of engineering management to make certain that the engineer is aided not only in advancing his technical skill, but also in developing his ability to live with and deal with people. Whether his chosen field be design, development, research, sales, or management, this ability is essential.

If we concentrate on the fact that the greatest handicap of the young graduate engineer is his inability to deal with people, it follows logically that he can best overcome this difficulty by constant contact with people. Thus his work should be such that he is offered many opportunities to practice human relations. One method of accomplishing this is a rotational program in which the young engineer performs a series of different and varied assignments. These should be such that he contacts people throughout the organization. Whenever possible, he should accompany sales personnel to discuss engineering problems with customers. Contacts such as these, designed to develop the confidence of the young engineer, are among the first steps to be taken in educating him in human relations.

Additional responsibilities should be given the young engineer as rapidly as he proves himself capable of absorbing them. This is best accomplished, not by directing or bossing his activities, but by guiding him. The old law that "a good government is that which governs least" is applicable to engineering administration as well as to government. Engineering management must build a functional framework to govern the activity of the department and allow the engineer the greatest possible authority and freedom within that framework.

And always, there should be educating and training by example. The best and most effective means of widening the horizon of the young engineer is the constant example of a judicious, forward-looking supervisor who is, himself, a natural leader.

The complexities of engineering make teamwork among supervisors necessary. Periodic meetings should be held to enable the supervisor to perceive the viewpoint of others. Executives from other departments should be invited to discuss from their points of view the relationship of their work with engineering. In addition, the over-all function of the company as an entity should be explained to as large a degree as is practically possible. This is another step toward giving the supervisor the perspective of management which he can, in turn, transmit to the young engineer to widen his horizon.

We certainly agree with the author that engineering economics must be practiced in all phases of engineering design. Too often the engineer is inclined to forget completely that economy of manufacture is essential. In order to give young engineers a knowledge of production problems, they should be assigned duties which will bring them in direct contact with the manufacturing division. This will give them a cost consciousness which they will carry with them when they return to design work.

The process of widening the business horizon of the engineer must be continuous and must not be haphazard. Engineering management should keep a continuous close contact with the young engineers' development and guide their efforts into those fields of endeavor for which they are technically qualified and individually suited. As an aid in such guidance, engineering management should make use of aptitude tests to determine their ability, interest, and personality patterns. In addition, the work, progress, and potential of each man should be appraised formally at least once a year. The results of such appraisals should be correlated with the individual's personal choice in the assignment of his future activities.

We are essentially in agreement with the author's list of the six most important responsibilities of engineering management. The problem is to remember to apply them if we are to achieve the same skill in engineering management which we have in engineering design.

COMMENT BY C. R. SUTHERLAND[9]

The author has outlined a number of very important intangible working factors in the management of engineering activities. It is difficult to assign any one of them more importance than another. However, some are more important because of today's problems.

Communications could very well be the number one intangible factor in engineering management. The author points out how proper channels of communication should be maintained. In today's accelerated industrial activity, with the growth of large industrial departments, and the growth of technical advancements, communication means more than a two-way conversation. It means the proper dissemination of technical know-how. It means the proper transferring of huge portions of specifications. It is also the

[7] Engineering Manager, Vickers, Incorporated, Detroit, Mich.

[8] Intangible Factors in Engineering Management," by C. A. Butler, Jr., MECHANICAL ENGINEERING, vol. 75, September, 1953, pp. 706–708.

[9] Engineer, Charge of Mechanical Product Development, The Reliance Electric and Engineering Company, Cleveland, Ohio. Mem. ASME.

basic means of accomplishing and completing scheduled projects. Common agreement and understanding of new designs is accomplished by proper communication. Committee meetings, specifications, conferences, drawings, and even luncheon discussions are all part of the method of getting things accomplished through communications. Communications is a subject which has been left for casual planning. Nevertheless, it is one of the intangible factors which, if properly administered, can give us astoundingly profitable results.

AUTHOR'S CLOSURE

The author wishes to thank Mr. Seidel and Mr. Sutherland for their complimentary comments on his paper. The elaboration which they make on certain points is most helpful.

Since writing this paper, we have been informed that a person in a professional or creative endeavor usually reaches the peak of his accomplishment when he is somewhere between thirty and forty years of age, whereas a manager or business man usually reaches the peak of his accomplishment when he is between fifty and sixty years of age.

This should be a challenge to our profession. If properly guided, many engineers could change gradually from professional to management work somewhere during their fortieth and fiftieth year and contribute to society both the maximum potential in creative endeavor and later in the field of management.

C. A. BUTLER, JR.[10]

[10] Diamond Alkali Company, Painesville, Ohio.

Gas Turbines and Centrifugal Compressors

COMMENT BY C. R. HETHERINGTON[11]

In his Fig. 3, the author of this paper[12] gives a clear picture of the hydraulic match of centrifugal compressors and gas pipe lines by superimposing centrifugal compressor and pipe-line characteristics. The pipe-line system operates at the intersection of the two characteristic curves. It is clear from these curves shown in Figs. 3 and 4 how the centrifugal compressors on the El Paso system will operate with the pipe line to provide the gas volumes desired to be pumped. These units appear to be ideally suited to the expansion of the El Paso system.

The El Paso system was developed to large-volume capacity before the use of these compressors was considered. The use of these units on new pipe lines is substantially different, however, and it would be of interest to hear from the authors about similar characteristic curves for pipe-line systems just starting to operate.

In this case considerably different problems are encountered. A pipe line to a new area generally starts out at rather low capacity, and the capacity is increased yearly by the addition of compressor horsepower. In such a case the range of flow over which the centrifugal compressors must work is substantially greater than that required in the operation of the El Paso system to expand capacity. A new pipe line, too, generally does not have compressor stations of such a large size and, accordingly, units of 5000 hp may not be completely adaptable.

The compressors required in the initial installation must handle much smaller volumes than will be required to be handled in later years. The compressor stations will be of smaller horsepower and accordingly will contain a smaller number of units. The matter of providing spares must be considered. In the case of small compressor stations the matter of spares is particularly important when large units of 5000 hp are being considered.

The adaptation of gas turbines and centrifugal compressors as yet has not been worked out adequately for a new pipe-line system undergoing substantial expansion from small initial volumes to large ultimate volumes. The method of operation, however, can be shown readily on the superimposed characteristic charts as given in the paper, and the problems to be encountered can be seen. One major contribution to this paper is the presentation of these characteristic charts which will be of great value in depicting the performance of centrifugal compressors for natural gas pipe lines.

[11] West Coast Transmission Company, Limited, Calgary, Alberta, Canada.

[12] "Gas Turbines and Centrifugal Compressors as Applied to Natural-Gas Pipe-Line Service," by T. R. Rhea and J. S. Quill, MECHANICAL ENGINEERING, vol. 75, July, 1953, pp. 534–540.

COMMENT BY J. J. KING[13]

The writer's company has had a 5000-hp gas-turbine-driven high-pressure centrifugal compressor in operation near Morehead, Ky., since the early part of 1952. Experience to date with this unit indicates that the fundamental design is sound, even though some difficulties have been encountered with the unit. Most of the difficulties, however, have been of a minor nature, such as are usually found with a new piece of equipment.

It is the writer's belief that the future is bright for combustion gas-turbine-driven centrifugal compressors for large-capacity gas-transmission pipe-line systems.

The statement is made that reciprocating compressors do not lend themselves to very low compression ratios at very satisfactory efficiency. The over-all accuracy of this statement is not questioned. However, in an effort to be somewhat more precise, we have determined that a pressure ratio of approximately 1.2 marks the intersection of the BHP per MMCFD curves for the most efficient reciprocating compressor and the best centrifugal compressor now available. For ratios greater than approximately 1.2, the reciprocating compressor will indicate a slight advantage, and for ratios smaller than 1.2, the centrifugal compressor is favored, although differences are very small. Since station ratios are seldom smaller than 1.2, it is our experience that for pressure ratios between approximately 1.2 and 1.6, the selection of compressor type should be made on other overriding factors, since it is a virtual standoff on a BHP per MMCFD basis.

The ratio of 1.33 as an approximate, feasible upper limit for a single centrifugal impeller appears to be generally accepted throughout the industry, and is the foremost argument against placing centrifugal compressors in parallel on the pipe line, for once that ratio is reached, no more gas can be passed through the system without construction of additional pipe line, or unless system pressures are increased, which is hardly feasible. Multistage compressors (i.e., more than one stage in one case) have too low an efficiency to even be considered.

With a design flow of 1050 MMCFD at 813 psia discharge, it appears from Fig. 5 of the paper that an average pressure ratio for a station is about 1.2. We believe that station high-pressure gas piping must be sized very liberally and efficiently designed in order to prevent the suction and discharge pressure losses within the station proper from becoming an appreciable portion of the over-all ratio. Any release of data concerning recommended pipe and valve sizes and flow velocities (based preferably on actual field tests) would be considered most helpful.

Under "Station Valving" the automatic sequence of starting is explained,

[13] Vice-President, Tennessee Gas Transmission Company, Houston, Tex.

wherein with a dead station the suction, discharge, and purge valves are closed and the vent and station by-pass valves are open. The authors then state that when the turbine first fires, the purge valve opens, and 10 sec later the vent valve closes. This allows only 10 sec to purge the compressor case and the piping on each side of it up to the suction and discharge valves. It is felt that a longer purging period should be allowed to prevent against any air whatsoever being trapped.

Consider a hypothetical case of a line break on the immediate discharge of a centrifugal station. Almost instantaneously an enormous pressure ratio would exist across the compressor, and in such a case, the centrifugal impeller would act as an inefficient turbine. Do the authors consider the overspeed to be sufficient safeguard for protection of the turbine, or in addition, should a pressure or flow-actuated device be installed which, in such an emergency, would close the suction or discharge valve automatically?

It would be of greatest interest if fuel requirements in SCFH per BHP could be obtained for various loads up to full load, from actual field measurement. It is desired that accurate, practical values of fuel consumption, actually measured in the field, be available for comparison with reciprocating-engine fuel requirements.

AUTHORS' CLOSURE

For systems just starting to operate, the gas-turbine-driven centrifugal compressor, without an expensive change in compressor casing, can be made suitable for design flows from 250 to 700 MMSCFD. If the line starts out at 250 MM flow the first year, the horsepower available from the 5000-hp unit would not be fully used with single-stage compressors. However, as the flow grows yearly, of course additional horsepower must be added, but the original compressor casings with new impellers could be used.

When the line reaches a flow of 600 MM then a larger compressor casing would be in order and this larger compressor casing would take the line up to 1000 or 1200 MMSCFD, with changes in wheels at judicious increments of flow.

However, as Mr. King points out, when the flow exceeds 1200 MM, it is time to consider centrifugal compressors in parallel because of the drop within the station piping at these very great flows. El Paso reports about 16 lb drop in the valves and elbows at these flows for 3 units in series.

The authors can see no problem in applying this size gas turbine to either new or old lines from flows of 250 MM to 1200 MM. Indeed, since the paper was written it has been successfully applied to all the ranges of rated flows between 250 MM and 1200 MM.

T. R. RHEA.[14]
J. S. QUILL.[14]

The Interferometer as an Industrial Tool

COMMENT BY JAMES R. BENFORD[15]

The durable and nonabsorbing films which the author[16] has used add much to the attractiveness of the interferometer method as a practical industrial tool for metals.

It will be interesting to see the extent to which this practical method for sharpening of the fringe system increases industrial use of the optical flat, long an indispensable tool in controlling surface accuracy of glass in the optical industry. The basic design concept can of course be extended to become a higher power system by locating the microscope objective below the partially reflecting mirror (Fig. 7 of the paper), so that one can employ a traditional metallurgical microscope and vertical illuminator setup as the basis for constructing a microinterferometer. This would extend the power range, but lose the excellent design feature of a portable instrument which one can place directly on the test surface.

COMMENT BY ERWIN G. LOEWEN[17]

The thorough study of fine finishes has long been handicapped by the lack of reasonably priced and readily available instruments suitable for the purpose. Therefore the author has made a very important contribution to the field by transforming an elaborate laboratory technique into a relatively simple and readily portable instrument. It is the more remarkable because it represents at the same time the ultimate resolution of scratch depth that can be attained today. The many manufacturers concerned with production of fine finishes owe a vote of gratitude to the author for the disclosure of his design.

Unfortunately, multiple-beam interferometry has some drawbacks. The most important is that the wedge required between the mirror and work surface makes it impossible to focus the viewing microscope on both fringes and work surface simultaneously. In photographs this might be remedied by double exposure if refocusing is possible without joggling the apparatus.

The idea of applying interferometry to surface-finish measurement appears to date back to 1933, when Linnik[18] proposed modifying a Michelson interferometer by making it part of a microscope. Such an instrument is called a two-beam interferometer to distinguish it from the multiple-beam one discussed in the foregoing. A recent modification of it is described by Räntsch[19] and is shown schematically in Fig. 1 of this comment.

Light from source L is split by the semireflecting prism P into two beams

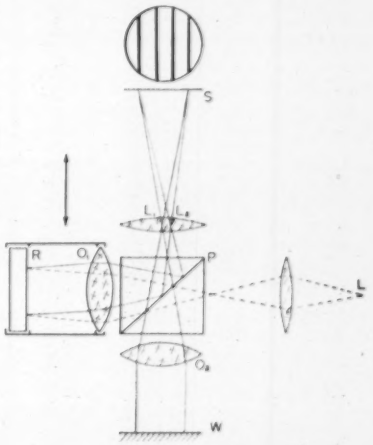

FIG. 1 TWO-BEAM INTERFEROMETER

One goes through objective O_1 to the reference mirror R and is reflected back to finally form an image at screen S. The other beam, which will form interference bands with the first, goes through objective O_2 to the work surface W where it is reflected to form an image at S. The interesting feature of this design is that both R and W remain perpendicular to their respective optical axis. The separation that is necessary between exit pupils L_1 and L_2, and which determines the spacing of the interference lines on S,

[14] Chemical and Petroleum Section, Industrial Engineering Department, General Electric Company, Schenectady, N. Y.

[15] Head, Visual Instruments Department, Scientific Bureau, Bausch & Lomb Optical Company, Rochester, N. Y.

[16] "An Interferometer for Examining Polished Surfaces," by Ronald E. Sugg, MECHANICAL ENGINEERING, vol. 75, August, 1953, pp. 629–631.

[17] Assistant Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. Jun. ASME.

[18] "Ein Apparat sür Mikroskopisch-Interferometrische Untersuchung reflektierender Objekte (Mikeroinferometer)," by W. Linnik, C. R. Academy of Sciences, USSR, 1933, p. 21.

[19] "Grundsatzliches zur Interference-Mikroscopie," by Kurt Räntsch, *Werkstattstechnik und Maschinenbau*, vol. 42, 1952, pp. 434–437.

is provided by moving the assembly of O_1 and R parallel to itself as indicated by the arrow. One result is that both fringes and work surface can be brought into sharp focus simultaneously. Measuring accuracy of 1.5 μ in. is claimed, with improvement to 0.5 μ in. possible by special techniques. If objectives O_1 and O_2 are selected so as to be optically identical and the path lengths of the two beams adjusted to be the same, then it is possible to observe interference with white light. This results in a very bright image and, among other things, makes it easy to evaluate the height of sudden steps, which is very difficult to do with monochromatic light. However, it should be obvious that the two-beam is a much more difficult instrument to build than the multiple-beam interferometer.

Räntsch[19] also reports measuring scratches on awkward surfaces such as holes, small pins, and gear teeth by making plastic replicas of these surfaces. He finds it necessary to change the reflectivity of reference mirror R to match the replicas, this being simpler than coating each replica with a reflective metal film. It would be interesting to hear if the author has been able to apply the replica technique to his instrument, since that would increase its field of usefulness greatly.

AUTHOR'S CLOSURE

The use of a traditional metallurgical microscope, as mentioned by Dr. Benford, offers a very satisfactory means of surface examination by multiple-beam interferometry when the part is small enough to be placed on the microscope stage.

The two-beam microinterferometer described by Professor Loewen, possesses certain advantages (and disadvantages) over multiple-beam interferometry. Its most attractive feature is that magnification to the limit of light microscopy (2000–3000×) may be used. This means that sharp edges, minute holes, small wires, and other objects of sharp radius may be clearly resolved and evaluated, as well as flat or large curved surfaces. However, inherent resolution in the two-beam fringe itself is poor compared with that in the multiple-beam fringe with a resulting deficiency in depth resolution.

We have used a prototype microinterferometer, made by the Bausch & Lomb Optical Company, for about three years and have found this and the multiple-beam instrument complementary in their applications. The use of white light, mentioned by Professor Loewen, is not possible with our instrument. However, it is very important in extending the range of microinterferometry and is provided for in the instrument recently placed on the market by Carl Zeiss, Inc.

We use a replica method to permit examination of otherwise inaccessible surfaces, but do not agree that changing the reflectivity of the reference mirror to match the replica is a satisfactory procedure, especially when photographic records are to be made. In our case, it has always resulted in indistinct fringes, and it has been necessary to coat the replica with a reflecting film, such as aluminum, by thermal evaporation in vacuum.

R. E. SUGG.[20]

[20] E. I. du Pont de Nemours & Co., Inc., Mechanical Development Laboratory, Wilmington, Del.

Printed Wiring

COMMENT BY R. B. ALBRIGHT[21]

The author has covered very ably the processing and use of metal-clad laminates in printed circuitry.[22] Regarding the use of metal-clad laminates for circuit layouts, there are some problems. Owing to the drop test to which electronic equipment is subjected, the size of the plastics-clad piece is limited. In any event, it must be well supported by metal bracketing or the cabinet. This also would be a function of weight and location of parts, and the problem of miniaturization of components becomes a factor.

No great problems present themselves on soldering. Bridgeovers and leakage paths must be avoided. Present-day condensers and resistors especially are hard to solder because of the present wire coating. Suppliers of these components should make a lower temperature and more uniform coating when the components are to be used for printed wiring. The leads also can be cut shorter if properly bent, thus saving considerable quantities of wire.

Unless the solder is desirable for reducing resistance and increasing the strength of the conductor, selective soldering is desirable to prevent bridgeovers and leakage paths. This may be done with masks or selective etching using two or more metals. Blistering of the foil during soldering must be avoided in order not to reduce the pull-test figure required by the Underwriters' Laboratory. Charring of the laminate by too high a temperature also would ruin the piece.

The chemical problem of etching is one not usually found in an electronics-assembly plant. The silk screening of the laminate with proper registration, fumes, and handling of chemicals, and so on, present grave problems for the radio manufacturer. It would be better if the piece were brought in from an outside supplier completely fabricated and ready for the components to be put on. However, prices at present are out of line and no one on the outside seems set up to run 50,000 to 100,000 or more pieces a week. Any changes required on the electronic equipment might present a serious problem if the work is done outside the radio plant or too far in advance of production.

In cases where the chemical etch does not remove the cement which holds the foil, as in the case of silicone Fiberglas, the properties of the base material are reduced. Absorption of the etching chemical also must be prevented with some types of Fiberglas.

The foregoing are but a few of the problems encountered in the application of printed wiring. There are also other methods of accomplishing printed wiring, several of which look interesting.

It is hoped this comment will give more insight into problems involved in printed wiring with metal-clad laminates.

AUTHOR'S CLOSURE

Mr. Albright's comments cover some of the problems involved in the use of metal-clad laminates. These comments are helpful to the producer of metal-clad laminates as well as to the user.

N. A. SKOW.[23]

[21] Philadelphia, Pa.

[22] "Metal-Clad Laminates Used in Printed Circuitry," by N. A. Skow, MECHANICAL ENGINEERING, vol. 75, September, 1953, pp. 709–711, 714.

[23] Director of Research, Synthane Corporation, Oaks, Pa.

Electromagnetic Pumps

COMMENT BY F. H. FISH, JR.[24]

Efficiency of the Faraday type pumps[25] is a function of the ratio: Conductance of the pumped material to conductance of the thin-walled section of pipe in the magnetic gap.

Substitution of a ceramic material (i.e., highly resistive) for the metallic thin-walled section would appear to be a means for making this class of pump more versatile, especially in applications having a low conductivity material—lead, for instance—as the pumped fluid.

[24] Remington Arms Company, Inc., Engineering Service Division, Bridgeport, Conn. Assoc. Mem. ASME.

[25] "Electromagnetic Pumps for High-Temperature Liquid Metals," by C. F. Cage, Jr., MECHANICAL ENGINEERING, vol. 75, June, 1953, pp. 467–471.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Industrial Heat Transfer

DER INDUSTRIELLE WÄRMEÜBERGANG. By A. Schack. Verlag "Stahleisen," Dusseldorf, Germany, fourth edition, 1953. Cloth, $6^1/_4 \times 9$ in., 64 figs., 34 tables, 400 pp., 38.50 DM.

REVIEWED BY W. TRINKS[1]

The book starts with heat flow into and through plates and tubes, for steady and for transient conditions. The graphical method of finding transient temperature distribution is given for plates only, but not for cylinders or spheres. Several theories on heat transfer by convection are compared, for laminar flow and for turbulent flow along plates, in tubes and through banks of tubes. Seven pages are devoted to heat transfer by condensing vapors. Radiation from solid bodies, from clear furnace gases, and from luminous flames is discussed. One equation on radiation from clear gases reaches three times across the page. Detailed attention is given to the calculation of heat-exchangers, such as recuperators and regenerators. This is easily understood, because the author designs, makes, and sells recuperators. The section on the mechanism of heat transfer in industrial furnaces is rather brief. The section on the relation between pressure drop and heat transfer is very good. Numerical examples take up 46 pages.

The author was the first (30 years ago) to call attention to gaseous radiation in furnaces. His book is treasured in Germany—hence the fourth edition. The reviewer may be too critical, but can see much that might be better and more complete. Nevertheless, he recommends the book to those who have to design recuperators and regenerators. The English translation of an earlier edition did not sell well in the United States. However, this poor showing may largely be attributed to a very poor translation. The reviewer thinks a lot of Dr. Schack.

[1] Professor emeritus, Carnegie Institute of Technology, Ohiopyle, Pa. Fellow ASME

Books Received in Library

APPLICATION DE LA NOTION D'ÉCHAUFFEMENT RELATIF A L'ÉTUDE DE LA CONVECTION FORCÉE DE LA CHALEUR. By Edouard Roche. France, Ministère de l'Air, Publications Scientifique et Technique, no. 267, Paris, France, 1952. 77 p., $10^5/_8 \times 7$ in., paper. 750 Fr. fr. An application of the theoretical aspects of heat transfer to the study of forced convection under various conditions. Formulas and graphs are developed and applied, and tables of the required physical constants of various gases and liquids are provided.

ASME HANDBOOK. Metals Engineering—Design. Edited by Oscar J. Horger. Sponsored by the Metals Engineering Handbook Board of The American Society of Mechanical Engineers. McGraw-Hill Book Company, Inc., New York, N. Y., first edition, 1953. 405 p., $10^1/_4 \times 7^1/_2$ in., bound. $10. Some forty authorities summarize the important reference data and discuss the essential properties which need to be evaluated by the design engineer in his selection of materials, beginning with an over-all discussion of the problem. Section 2 on mechanical properties covers high-temperature considerations, plasticity, stresses, vibration, fatigue, cold-working, impact, and other considerations. Part 3 deals with corrosion and mechanical factors which influence corrosion. Part 4 presents metallurgical factors, mainly dealing with nondestructive methods of testing. Part 5 considers the requirements for mass production and surface finish. Part 6 treats design theory and practice, and miscellaneous topics such as elasticity, strain gages, photoelasticity, plates and shells, and the special requirements of aluminum and magnesium.

CONSTANTES THERMODYNAMIQUES DES GAZ AUX TEMPÉRATURES ÉLEVÉES. By M. G. Ribaud. France, Ministère de l'Air, Publications Scientifique et Technique, no. 266, Paris, France, 1952. 169 p., $10^5/_8 \times 7$ in., paper. 1500 Fr. fr. A discussion of the thermodynamic constants of gases at high temperatures, covering both the theoretical and practical aspects, including corrections to be applied in converting from the "perfect-gas" state to actual gases. Numerical values are presented in tabular form for some 50 gases—simple elements, inorganic compounds, various hydrocarbons, and some monatomic forms.

DISLOCATIONS AND PLASTIC FLOW IN CRYSTALS. By A. H. Cottrell. Oxford University Press, London, England, 1953 (distributed in U. S. by Oxford University Press, New York, N. Y.). 223 p., $9^3/_4 \times 6^1/_4$ in., bound. $5. This study covers the interpretation of slip in crystals; elastic properties of dislocations; dislocations due to crystal structure; theories of the yield strength; and working, hardening, annealing, and creep. Writing for metallurgists and engineers as well as for theoretical and experimental physicists, the author has emphasized the qualitative physical ideas rather than their formal mathematical development and has kept the mathematics to a minimum. Numerous citations to the literature of the subject appear throughout.

DRUCKWELLEN-SPULUNG BEI ZWEITAKTMOTOREN. (Mitteilungen aus dem Institut für Thermodynamik und Verbrennungsmotorenbau an der E.T.H., No. 12.) By Yian-Nian Chen. Verlag Leeman, Zürich, Switzerland, 1953. 93 p., $9^3/_8 \times 6^5/_8$ in., paper. 10.40 Sw. fr. A dissertation on pressure-wave scavenging in two-stroke engines, which provides both a theoretical discussion and a report on an experimental investigation of a diesel engine, fully detailed with graphs and calculations throughout.

ELEMENTS OF HEAT TREATMENT. By George M. Enos and William E. Fontaine. John Wiley & Sons, Inc., New York, N. Y., 1953. 286 p., $9^1/_4 \times 6$ in., bound. $5. This volume describes the basic theory involved in the heat-treatment of metals in simple, straightforward language. Following introductory chapters on the properties of metals and alloys, the major heat-treatment processes—annealing, normalizing, hardening, and tempering—are discussed in detail. Other operations such as forging, rolling, pressing, machining, welding, and casting are briefly described. Graphs and tables of pertinent data are included.

ENGINEERING STATISTICS AND QUALITY CONTROL. By Irving W. Burr. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 442 p., $9^1/_4 \times 6^1/_4$ in., bound. $7. A textbook designed primarily for undergraduate and graduate students, but of interest also to engineers and executives in industry who are concerned with statistical quality control. Subjects covered include frequency distribution, the normal curve, control charts, probability, sampling, and the place of statistics in an industrial organization. A glossary of standard symbols is included.

ÉTUDE GÉNÉRALE DE L'ÉCOULEMENT D'UN GAZ A TRAVERS UNE TUYÈRE QUELCONQUE ET DU PASSAGE PAR LA VITESSE DU SON. By Max Serruys. France, Ministère de l'Air, Publications Scientifique et Technique, no. 272, Paris, France, 1952. 62 p., $10^5/_8 \times 7$ in., paper, 750 Fr. fr. A mathematical analysis of gas flow through a pipe, specifically at the speed of sound and mainly in a steady state. The effects of the application of heat are considered as well as a number of other varied conditions.

FATIGUE OF METALS. By R. Cazaud. Translated by A. J. Fenner. Philosophical Library, New York, N. Y., 1953. 334 p., $10 \times 6^1/_2$ in., bound, $12.50. This volume is essentially a survey of the characteristics and behavior of metals under cyclic stress, the practical side of which is emphasized by taking into account the effect of contributing factors such as size and shape of parts, surface conditions, temperature, and corrosion. Test methods and testing machines are explained and described. The final chapter on "improving the fatigue strength of machine components" represents

an important part of the author's aim in writing the book.

FOURTH SYMPOSIUM (INTERNATIONAL) ON COMBUSTION. At Massachusetts Institute of Technology, Sept. 1–5, 1952. Williams & Wilkins Company, Baltimore, Md., 1953. 926 p., $10^1/_4 \times 7$ in., bound. $7. The range of topics of the papers presented in this symposium was limited in order to place emphasis on the physical aspects of combustion, treated from both experimental and theoretical standpoints. The 112 papers are broadly classified under the following headings: flammability; ignition; laminar combustion and detonation waves (50 papers); cellular flames and oscillatory combustion; turbulent flames; quenching, flash back, and blow off; stabilization by flame holders; fuel jets; burning of fuel droplets; combustion in rockets and engines; and survey papers.

HANDBUCH DER HARTMETALLWERKZEUGE. Volume 1: Herstellung und Anwendung von Dreh-und Hobelwerkzeugen. By W. Dawihl and E. Dinglinger. Springer-Verlag, Berlin, Germany, 1953. 237 p., $9^1/_2 \times 6^1/_2$ in., bound. 15.60 DM. This first of a two-volume text on cemented carbide tools deals with the manufacture and effective use of lathe and planing tools, beginning with basic properties and principles and ending with work preparation and special applications. An appendix contains tabulated technical information on materials and tools. Other tool types, such as borers, millers, etc., will be treated in the second volume.

HEAT TRANSFER. Engineering Research Institute, University of Michigan, Ann Arbor, 1953. 286 p., $9^1/_4 \times 6^1/_4$ in., bound, $5. A group of eleven lectures by authorities in the field opening with a discussion of heat-transfer problems in general and, in particular, the effect on materials of high thermal gradients. Succeeding lectures discuss specific problems that arise when thermal gradients are present in materials ranging from solids through liquid metals, liquids, and gases, including rarefied-gas dynamics. Each of the papers includes a list of references.

INDUSTRIAL SPECIFICATIONS. By E. H. Mac Niece. John Wiley & Sons, Inc., New York, N. Y., 1953. 158 p., $9^1/_4 \times 6^1/_4$ in., bound, $4.50. After an opening chapter on the need for better specifications, the author discusses the following topics: concepts of variability and tolerance; relations between supplier and purchaser; standardization and simplification; raw-material, process, and product specifications; governmental and institutional specifications; standard procedures and job specifications. The last chapter outlines practical methods for preparing and maintaining specifications.

INTRODUCTION TO AERONAUTICAL ENGINEERING. Volume 1: Mechanics of Flight. By A. C. Kermode. Sir Isaac Pitman & Sons, Ltd., London (distributed in U. S. by British Book Centre, Inc., New York, N. Y.). sixth edition, 1952. 372 p., $9^3/_4 \times 5^3/_4$ in., bound. $4.50. One of a series of three volumes dealing with the elements of aeronautical engineering. It covers airflow, airfoils, propulsion methods, level flight conditions, gliding and landing, performance characteristics, stability and control, and high-speed flight considerations. The volume has been thoroughly revised including the addition of jet and rocket-propulsion principles and the entire chapter on high-speed flight. Additional practical data are appended.

INTRODUCTION TO RELAXATION METHODS. By F. S. Shaw. Dover Publications, Inc., New York, N. Y., 1953. 396 p., $8^1/_4 \times 5^1/_2$ in., bound. $5.50. A detailed guide for solving problems arising in fluid mechanics, the design of electrical networks and machinery, forces in structural frameworks, stress distribution, electron-optics, and many other fields. The broad application of the book has been made possible by emphasis on the different types of equations solvable by these methods rather than on specific subject problems. The treatment is logical and detailed.

KREISELGEBLASE UND KREISELVERDICHTER. By Friedrich Kluge. Springer-Verlag, Berlin, Germany, 1953. 301 p., 11 × 8 in., bound, 58.50 DM. Intended for students as well as design engineers, this text on turboblowers and turbocompressors of radial design covers both theory and practice. Topics covered include physical principles, single and multiple-stage machines, control, principles and devices, machine elements assembly, and operation.

MACHINES THAT BUILD AMERICA. By Roger Burlingame. Harcourt, Brace and Company, New York, N. Y., 1953. 214 p., $8^1/_4 \times 5^1/_2$ in., bound. $3.50. A history of the development of American mass production seen as the result of the demands of economic necessity and as a factor in the westward settlement and unification of the United States. The historical background and influence of many inventions are discussed, and the contributions of numerous inventors—Oliver Evans, Hargreaves, Howe, Eastman, and Ford, among others—are described.

MODERN PLASTICS ENCYCLOPEDIA AND ENGINEER'S HANDBOOK, 1953. Plastics Catalogue Corporation, New York, N. Y., 17th edition, 1953. 943 p., $11^1/_2 \times 8^1/_2$ in., bound. Available to subscribers of *Modern Plastics* magazine. As in the previous editions, this useful reference work presents in detail recent developments in plastics engineering and methods, machinery and equipment, and plastics materials. A major section is now devoted to film and sheeting, and also to laminates and reinforced plastics. The technical-data section includes the large, folded plastics-properties chart, and the directory section provides buyers' guides and a list of trade names.

POWER PLANT ENGINEERING. By Frederick T. Morse. D. Van Nostrand Company, Inc., New York, N. Y., third edition, 1953. 687 p., $9^1/_4 \times 6^1/_4$ in., bound. $8.75. Although extensively revised, this text retains the same objective: the presentation of a thorough study of stationary power and heating plants, including public service, industrial, and institutional varieties. Fundamentals are given primary consideration, omitting details and dimensions of equipment, and the power plant is emphasized as an integrated assembly with more space devoted to the small plant than before. Load problems, economics, and instrumentation are dealt with.

REGULATION HYDRAULIQUE D'ALIMENTATION DES TURBOMACHINES. By Basile Demtchenko. France, Ministère de l'Air, Publications Scientifiques et Techniques, no. 277, Paris, France, 1953. 182 p., $10^3/_4 \times 7$ in., paper. 1500 Fr. fr. This text includes a detailed presentation of schematic and mathematical analyses of hydraulic control methods of combustion-gas flow in turbomachines with particular reference to gas turbines and jet propulsion for airplanes. Part 1 contains the theoretical treatment; Part 2 describes applications, including the operation of existing types.

SYMPOSIUM ON CONTINUOUS ANALYSIS OF INDUSTRIAL WATER AND INDUSTRIAL WASTE WATER. (Special Technical Publication, no. 130.) American Society for Testing Materials, Philadelphia, Pa., 1953. 54 p., 9 × 6 in., paper. $1.50. The five papers included deal with the following: automatic sampling of industrial water; measurement of pH, electrical conductivity, etc.; continuous recording of chlorine residuals; measurement of color, turbidity, hardness, and silica; and continuous measurement of dissolved gases.

SYMPOSIUM ON STRENGTHS AND DUCTILITY OF METALS AT ELEVATED TEMPERATURES. (ASTM Special Technical Publication, no. 128.) American Society for Testing Materials, Philadelphia, Pa., 1953. 249 p., 9 × 6 in., bound. $3.25. Eight of the twelve papers presented deal with the effects of notches on metals at elevated temperatures, under either static or dynamic loading, and discuss results of current research on the subject. The other four papers are concerned with metallurgical changes: recovery and creep in an alloy steel, studies of the strength, ductility, and other properties of both low and high-alloy steels at elevated temperatures.

TABLES OF NORMAL PROBABILITY FUNCTIONS. (Applied Mathematics Series, no. 23.) National Bureau of Standards. Available from Superintendent of Documents, G.P.O., Washington 25, D. C. (a reissue of Mathematical Table 14, with corrections) 1953. 344 p., $10^1/_2 \times 8$ in., bound. $2.75. A companion volume to the previously published tables of the error function and its derivative, this book presents a tabulation of the functions $Q(x)$ and $P(x)$ to 15 decimal places at intervals of 0.0001 in the range of x between 0 and 1, and of 0.001 for x between 1 and 7.8. An explanatory introduction and a bibliography are included.

TIMING ENGINEERING. By Myrten G. Saake. Ribble Engineering Company, Jersey City, N. J., first edition, 1953. 243 p., $9^1/_4 \times 6^1/_4$ in., bound. $5. This first full-length reference book on industrial timers covers basic design, construction, and application in relation to automation of machinery and processes. Single and multiple-circuit program timers and single and multiple-circuit automatic reset timers are described in detail with circuit diagrams. Synchronous motor-driven timers are mainly considered but brief mention is made of electronic, pneumatic, and thermal timers. A separate chapter deals with automatic counters.

Library Services

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ASME BOILER CODE

Announcement

Addenda for the 1952 (Ferrous) Edition of Section IX, *Welding Qualifications*, has been printed and is available from the Society.

ASME NEWS

With Notes on the Engineering Profession

Mexico in March—

1954 ASME International Meeting and Tour

Meeting at Hotel Del Prado, Mexico, D. F., March 10–12

ARRANGEMENTS have been completed for the tour of Mexico City, with side trips to such world-famous places as Acapulco, Cuernavaca, and Taxco, in conjunction with the 1954 International Meeting of The American Society of Mechanical Engineers. The meeting is scheduled for March 10–12, with headquarters at the Hotel Del Prado, Mexico, D. F.

Tour Starts March 8

The tour starts March 8 from Mexico City to Taxco and Cuernavaca; while the meeting is in session, the afternoons will be taken up with visits to places of interest in and around Mexico City, such as the museums, Chaputepec park and castle, the pyramids, the shrine of Guadalupe, University City, and Xochimilco; the tour will be ended with a visit to Acapulco.

The trip has been arranged by American Airlines with the assurance that every thought has been given to a comfortable, easy trip that provides ample opportunity to see as much of Mexico as the time allows. It is important that the ASME members and their party enroll for the tour in January in order to facilitate reservations on planes from their home cities to New York, N. Y., Chicago, Ill., or Los Angeles, Calif., from which points American Airlines maintains through service to Mexico City.

Those people planning to take the conducted tour will automatically eliminate travel complications and extra expenses. The planned trip rates include the full period of the ASME meeting in Mexico City, sight-seeing in and around the city, trips to Taxco, Cuernavaca, and Acapulco—guides where necessary, incidental transportation, admission to the bullfights, meals, hotel, and so on.

Numerous Rates Available

The rates for the whole trip, from arrival in Mexico on March 8 until departure from Mexico City in the evening of March 17, are $165 for each person for a double-room reservation, and $180, single; more or less depending on the hotel chosen, plus air fare from home to Mexico City. These prices include hotel room (all with bath); all meals, outside Mexico City; two luncheons and banquet during the meeting; all sight-seeing trips as specified with guides and fees; all transfers between airports and hotels; round-trip air fare from Mexico City to Acapulco; bullfight tickets with transportation to and from the bull ring, and guide's fee; all tips except to waiters in Acapulco; local Mexico Hotel, taxes included; and Mexico air tax of $2.45. A telephone call to your local airport or airline office will get you the round-trip rate from your city to Mexico City.

AERIAL VIEW OF MEXICO CITY WHERE 1954 ASME INTERNATIONAL MEETING WILL BE HELD AT HOTEL DEL PRADO, MARCH 10–12

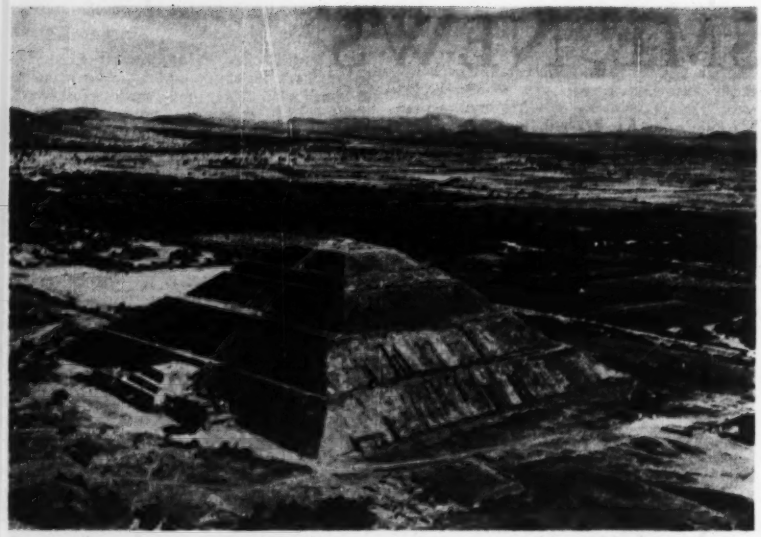
The afore-mentioned prices do not include meals in Mexico city, except the two luncheons and banquet which are part of the meeting; wine or mineral water, except at the banquet; tips to waiters in Acapulco; laundry, similar personal items; and tourist card.

The quoted price for room is for reservation at the Hotel Del Prado. There is a limited number of these rooms available; however, reservations are available at nearby hotels which may vary as much as five dollars—more or less. These hotels should suit any taste as they range from the modest hotels to the plush, newly opened Bamer Hotel.

For those who would omit the visit to Acapulco and return after seeing the bullfight on Sunday, leaving on the morning of Monday, March 15, there will be a saving of $55 for double-room occupancy, and $60 for single-room. On the other hand, for those who omit all trips outside Mexico City and omit the bullfight, there will be a saving of $110 on a double-room basis and $120 on single-room basis; for example, the expenses as outlined, total $55 for double room, for each person; $60, for single room, while in Mexico City.

Transportation

American Airlines plane fares, including tax from New York, N. Y., to Mexico City, are as follows: regular: $167.21 one way, $312.11, round trip; tourist: $113.85, one way, $227.70,



PYRAMID OF THE SUN

round trip; family plan (first-class fare): $250.82 for two one-way fares, double this amount for the round-trip fare. For members and their wives, the family plan applies on this trip schedule, except for those leaving Mexico City before March 15 or after March 17, unless they stay over until the next week.

A member traveling alone will save on the round-trip fare to Mexico City from home by using Tourist Service which is a new improved service now available via American Airlines. Those who must leave before March 15, who go family plan, may return for approximately the same price by using tourist on the return-trip portion of the air fare.

The members taking the full trip may return with $500 worth of merchandise, duty-free, and tax-free on jewelry and other luxuries. There is also an opportunity for savings on purchases, due to the present favorable rates of exchange, with approximately 8.5 pesos being obtained for an American dollar.

All who are interested in this trip are encouraged to write to Mr. Ernest Hartford, Deputy Secretary, ASME, 29 West 39th Street, New York 18, N. Y. This will not in any way incur obligation on the part of the member, with the assurance that he will be kept informed, but not annoyed, regarding developments. He will also receive literature to aid him in making decisions.

Mexico—Land of Contrasts

From the time of arrival in Mexico City, perhaps the most impressive factor is contrasts. In a climate that is best described as eternal spring, it is well to remember the altitude—take it easy; do not run; walk! Wear comfortable shoes; there will be a great deal of walking. In Mexico City there are many wonderful museums such as the Inter-American Native Institute and that of the Academy of San Carlos and others devoted to plastics, anthropology, history, popular arts and industries, and religious art. The trip to nearby Chapultepec, with its beautiful park and castle, is worth while. This was once the summer resort of Montezuma. The castle, which today is a beautiful museum, was in the eighteenth century the residence of Maximilian and Carlotta.

The tour includes a visit to the pyramids of Teotihuacan which were built about 900 A.D. by the Toltecs. The remains today comprise the huge Pyramid of the Sun, the slightly smaller Pyramid of the Moon, and the impressive Stadium with its perfectly preserved smaller temple of Quetzalcoatl.

The typical Mexican Sunday is in store—the morning visit to Xochimilco and its famed "floating gardens"—bustling with the activity of the flower weavers, the musicians, and the snack vendors. The gardens are said to date back to the tenth century. Originally they were rafts routed down through the canals to Mexico City bearing gifts to the Aztecs. The afternoon is devoted to the great national sport of Mexico, the bullfight. One may not be interested in the bullfight, but the plaza is special. At one time it was a quarry; later the seats were cut out of the wall, and today it is the largest bull ring in the world.

Two sights to be seen in Mexico City of much interest are the Shrine of Guadalupe, with its unusual art work, and University City.

The trip to Cuernavaca is one to be remembered. This vacation spot of old is just as popular today. Here one sees one of the oldest cathedrals on this continent, and the Palace of Cortes, which is a government office building. The wall of one of the Palace verandas is covered by Diego Rivera's murals, donated by Dwight Morrow, former U. S. Ambassador to Mexico. The Borda Gardens, once the pride of Empress Carlotta, are open to the public.

Taxco, founded in 1529, is a charming old silver city. The town is built over the mines, and the little streets that meander over the hills provide a quaint picture. At the side of the tiny plaza, where evenings are sometimes whiled away listening to a surprisingly versatile band of musicians from some neighboring village, is the church of Santa Prisca.

Last, but not least, is Acapulco. In colonial days Acapulco was Mexico's most important Pacific port, situated on one of the finest natural harbors in the world. It is at Acapulco that the famed diving boys of La Quebrada perform daily. There are many fine beaches. Along the coast near Copacabana there is deep-sea diving equipment, and the operator will accompany you on a drop into a world you've never known—far more exciting than a glass-bottom boat. Don't miss the ponderous waves at sunset at Pie de La Cuesta. This sight is well worth the short trip from Acapulco.

The Special Libraries Association Translations Pool

THE Special Libraries Association, in cooperation with the John Crerar Library, Chicago, Ill., announces a recently established translations service. It has been created in recognition of the increasing need for information regarding existing translations and for the availability of inexpensive copies.

The Association has deposited in the Crerar Library 1300 translations which form the nucleus of the Pool.

Arrangements are under way for the listing of future contributions in technological journals in the fields covered by the translations. Because the usefulness of the Pool will be in direct proportion to the number of translations available, contributions are solicited from government agencies, technical societies, universities, industries, and individuals. Contributions may be made by the deposit of good copies of complete translations. If copies are not available for deposit, they may be loaned to the Crerar Library for a short time, with permission to microfilm, or alternatively, a 35-mm microfilm may be deposited. Permission to lend or to reproduce in photocopy is a condition of deposit.

Contributions and requests for information regarding the availability of translations should be addressed as follows: S. L. A. Translations Pool, John Crerar Library, 86 East Randolph Street, Chicago 1, Ill. Photoprint or microfilm copies of the translations listed may be obtained at the regular rates charged by the Crerar Library. A price list will be sent on request.

21st ECPD Report Issued

AVAILABILITY of the twenty-first (1953) Annual Report of the Engineers' Council for Professional Development has been announced. High lights of the report include the work being done on counseling for high-school boys interested in entering engineering; the Cincinnati training program; and student development. In addition the publication contains reports of various committees on recognition, ethics, information, and reports of representatives of constituent organizations. The report may be ordered from ECPD, 29 West 39th Street, New York 18, N. Y., for 50 cents a copy.

UET Report for 1952–1953 Emphasizes Need for New Engineering Building

Finances, Engineering Societies Library, and Engineering Foundation Reviewed

THE annual report of the United Engineering Trustees, Inc., for the forty-ninth year, 1952–1953, was issued by R. F. Gagg, Mem. ASME, president UET, Oct., 22, 1953. The following excerpts are from Mr. Gagg's report:

Fifty years ago the Engineering Societies Building was planned as a permanent and commodious home for the professional engineering societies, a place where a large portion of their administrative and technical activities would be centered. It served its purpose very well. The building is one of the principal interests of UET, which is a co-operative venture of AIEE, AIME, ASME, and ASCE. Through their authorized representatives the Founder Societies incorporated UET in 1904 to act for them in "the advancement of the engineering arts and sciences in all their branches, and to maintain a free public engineering library." The definition is clear but not rigid.

Rapid strides in technology and the consequent expansion of engineering activities have long since outgrown the Engineering Societies Building. The four Founder Societies had approximately 11,000 members in 1903, and their activities encompassed the whole field of engineering work at that time. In 1953 the Founder Societies have a total of nearly 140,000 members, and at least a score of younger technical societies of professional stature are widely recognized in the engineering field. Their requirements for administrative offices and for technical meetings have long since outgrown the facilities available in the Engineering Societies Building.

Basic Requirements

It is therefore clear that the physical characteristics of a modern home for the professional engineering societies should include:

1 Sufficient modern office space to accommodate all administrative staff work in one location.

2 Sufficient space in one building to accommodate the several professional engineering societies which desire to be associated with the Founder Societies in the same location.

3 Committee meeting rooms for use in common by all associated groups.

4 Facilities for housing the Engineering Societies Library.

5 Suitable facilities for economical handling of records, mail, and similar community services.

6 A building planned to minimize the cost of occupancy and operations.

The present Engineering Societies Building does not meet these requirements and cannot economically be altered to meet them. Recognizing this situation, the Trustees have, during recent years, deferred maintenance and modernization except in instances where safety or continued utilization was impaired.

In view of the fact that even if the present building were to be completely repaired, the result would still be obsolete facilities, the Trustees have studied several suggested means for acquisition of a modern home for the engineering societies and have considered various locations in Baltimore, Chicago, Cleveland, Detroit, Washington, Pittsburgh, and New York.

The revised UET charter permits the sale of the present building, provided that specific approval be obtained in advance from the Supreme Court of New York. The funds provided to cover building depreciation have been segregated from other funds in order to facilitate action as may be required in connection with a new-building program.

Building Fund

A total of more than $3 million, plus some additional funds which can be made available by the Founder Societies, appears to be an ample foundation on which to finance the construction of a modern building of about 100,000 sq ft floor area, which would be adequate to accommodate the Library and for the needs of the Founder Societies. Means of raising additional monies have been considered.

If it is determined that other professional engineering societies are to join with the Founder Societies in a building program, then their financial participation should be arranged so that the added interest and amortization costs incurred to provide additional floor space for such societies is not proportionately greater than that necessary to provide space for the Founder Societies.

Attractive and practicable suggestions for location of a new Engineering Societies Building have been received from interested groups in Pittsburgh, Chicago, Washington, and New York, N. Y.

Financial Reports

The segregation of the depreciation fund from the other combined funds administered by the United Engineering Trustees, Inc., with complete separation of investment records, was carried out in accordance with the detailed recommendations of investment advisers in order that there would be no delay or challenge of favoring either fund in event of need for the sale of securities in connection with a building program.

The funds for which UET is custodian amount to approximately $291,000. These monies belong to the John Fritz Medal Board of Award, the Daniel Guggenheim Medal Board of Award, the Engineers' Council for Professional Development, and to various research projects of the Engineering Foundation.

ASME Members on the UET Board of Trustees are J. L. Kopf, R. F. Gagg, and W. F. Thompson.

Engineering Societies Library

Ralph H. Phelps, director, Engineering Societies Library, reported on the significant progress made in the Library in the past 40 years.

The relatively unorganized separate collections of 40 years ago have been combined, organized, and catalogued. Duplication has been eliminated and much material received years ago as gifts but of little value to engineers has been discarded. The Library has become outstanding in the fields of its Founder Societies—civil, electrical, mechanical, mining and metallurgical engineering—but its 170,000 volumes cover all branches of engineering, primarily on the level of graduate and practicing engineers. Some 1400 periodicals are currently received from all parts of the world.

Library Services

The Library Staff prepares reviews of hundreds of important engineering books each year; 445 books valued at $2755 were prepared this year. These reviews were supplied to the four Founder Societies, the Engineering Institute of Canada, and the Engineering Index. In addition to the value of books received for review, the Library spent about $1600 for books that were not reviewed. These and other books in the Library may be borrowed by members of the Founder Societies. Each year thousands of engineers and organizations use the Library's literature searching and translation services and its photoprint and microfilm copying services that are available to anyone anywhere without membership restriction. Other thousands use the public reading room of the Library.

Use of Library 1952–1953

Use of library services for which a charge is made continued to grow. More photoprint and microfilm orders were filled than in any previous year. More words were translated than in any previous year. Fewer, but longer, literature searches were made, so income was higher as was also income from all other paid services. More books were lent to members than in any previous year.

Statistics of Library Use

	1951–1952	*1952–1953*
Visitors served . . . . total	17,585	16,452
Nonvisitors served. . total	21,255	21,297
Total	38,840	37,749
Photostat orders	4,381	4,540
Photostat prints	53,003	60,243
Microfilm orders	176	388
Bibliography orders	206	109
Searches and paid services	153	147
Translations	184	170
Words translated	310,838	330,532
Borrowers	1,943	2,149
Books lent	2,803	3,179
Telephone inquiries	11,092	9,882
Written replies to inquiries	3,120	4,021

Acquisitions and Withdrawals

As of Sept. 30, 1953, the Library had 171,182 volumes, 14,945 maps, and 5386 searches. Six-

thousand-and-seven items were kept of the uncounted thousands of items which were received this year. More than a third of the 6007 items were gifts. They came from individuals, societies, companies, libraries, and schools. These gifts are very helpful as it is difficult or impossible to get some of the material through the usual commercial channels.

The policy and practice of upgrading the collection continues and little-used and out-of-date volumes were withdrawn from the collection and sold or discarded.

Periodicals

Periodicals form an important part of the Library's collection as they report new developments promptly and because many subjects are so specialized that they are treated only in periodicals.

Periodicals received	*1951–1952*	*1952–1953*
Subscription	376	351
Exchange	245	270
Gift	771	768
	1392	1389

Theodore Baumeister represents The American Society of Mechanical Engineers on the Engineering Societies Library Board. F. M. Gilbreth was appointed to the Board, March, 1953, and James S. Thompson resigned, December, 1952.

The Engineering Foundation

Reporting on the Engineering Foundation, UET, Frank T. Sisco, director, stated as follows:

At the annual meeting of the Engineering Foundation Board on Oct. 16, 1952, grants totaling $38,000 were approved for the support of 18 projects. All of these projects were active during the year and all made substantial progress. ASME, with five projects, was granted $11,000.

ASME Projects

All the current ASME-sponsored projects have been active in previous years. The first phase of the important research on the effect of pressure on the viscosity of lubricants (EF 23), which began in 1923, is completed, and during the present year the data obtained were published in a two-volume report. The Committee on Lubrication is now laying out a comprehensive series of machine-element tests in which these lubricants are to be used.

The Joint Committee of ASTM and AIME on the Effect of Temperature on the Properties of Metals (EF 45) raised a total of $82,400 in a two-year campaign for funds to continue the work of this outstanding group. During the year just ended, technical sessions were sponsored by the Joint Committee at the ASME and ASTM annual meetings, at which a large number of papers were read and discussed. Of these, 20 papers presented to ASTM were on testing and service of materials at low temperatures. Four research projects financed by the Joint Committee are currently active, and a fifth, on the properties of cast iron at elevated temperatures, has been authorized.

The ASME Research Committee on High-Temperature Steam Generation, whose work has been supported by the Foundation intermittently since 1932 (EF 50), has raised $28,300 during its recent solicitation of funds and expects to have an additional $81,500 available by the middle of 1954. Projects under way at present, or planned for the immediate future, include a study of the scale formed on surfaces exposed to steam between 1100 and 1500 deg F, a study of the resistance of ferritic and austenitic steels to the products of combustion of typical fuels, an investigation of the metallurgical stability of these alloys over long periods of time, and the determination of the effect of repeated temperature shock.

During the past year, work on the Properties of Gases and Gas Mixtures (EF 91) was confined primarily to the rare gases—helium, neon, argon, krypton, and xenon. The construction of the high-temperature apparatus for the range 400 to 900 deg C has been completed, and the equipment is in operation. Satisfactory results are being secured.

E. L. Robinson and H. Weisberg served as ASME representatives on the Board of the Engineering Foundation.

Engineering Research Institute Established at Tulane

THE formation of an Engineering Research Institute at Tulane University, to serve the needs of the expanding industry of this area, has been announced. The Institute will contract with industrial firms for specific research projects involving practical problems in numerous fields of engineering science.

About 20 faculty members of the school of engineering will take part in the work of the Institute, with physicists, chemists, and other specialists from various divisions of the University available as consultants on the projects.

Raymond V. Bailey, head of the department of chemical engineering, was named head of the Institute, to work under the general supervision of Lee Johnson, dean of the school of engineering.

Dr. Bailey described the Institute as a "formal, well-organized unit for sponsored research."

"There are innumerable engineering problems needing investigation in this area," he explained. "In the construction of offshore drilling structures, for example, or of port facilities on the Mississippi river, there are factors which are not found elsewhere and which have not been adequately studied.

"More efficient methods are constantly being sought in the chemical, petroleum, sulphur, and other industries centered in the vicinity. All types of manufacturing have engineering problems to be solved."

The Institute will offer research services in more than 20 specialized fields such as fluid flow, heat transmission, analog computations, electronics, prestressed concrete, stream pollution, illumination, metallurgy, and others, Dr. Bailey related.

Although many research projects are presently under way in the school of engineering, these have been mostly undertaken by individual faculty members. Dr. Bailey explained that establishment of the Institute will allow projects involving broader studies, cutting across the lines of specialists and even involving departments in other schools and colleges of the University.

Each project will be organized under the direction of a faculty member who is a specialist in the indicated field, he said, and other faculty members and graduate students will be assigned as the size and nature of the problem may require.

In addition to providing research leading to new solutions of practical engineering problems, Dr. Bailey pointed out, the program will promote the development of graduate instruction in the school by furnishing research fellowships for advanced students.

He said the Institute would provide services for the many small industries of the area which do not find it feasible to maintain research staffs, as well as for larger industries which have such staffs but which require additional help from time to time.

Nominations Sought for ASME 1954 Awards

ALL members or agencies of the Society, such as Council, Boards, Committees, Sections, and Professional Divisions, are encouraged to submit nominations for the various awards not later than March 1 of each year. Each nomination should be supported by the following: (1) Full statement of the training, experience, and notable contribution of the nominee; (2) statement of the basic reasons for submitting the nomination and for believing the nominee eligible for the honor; (3) a citation of about 50 words stating clearly the specific reason the nominee is recommended; (4) other information and reference which will assist the Board on Honors in considering the nominee.

It is absolutely essential that such nomination carry the present title and company connection of the candidate, or if he is retired, his present residence address.

Those wishing to make a nomination should first obtain a copy of the ASME Manual MS-71, Honors and Awards. This may be had by writing to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

Awards for 1954

Honorary Membership: Five may be awarded each year. An essential qualification is "eminence in the engineering field." These awards are not limited to Society members. Eminent engineers from other countries are eligible for consideration. A nominee must be endorsed by 25 members of the Society.

ASME Medal: This award is made for dis-

tinguished service in engineering and science and may be conferred in recognition of general service in science having possible application in engineering.

Holley Medal: The award is made for some "great or unique act of genius of an engineering nature that has accomplished a great and timely public benefit."

Worcester Reed Warner Medal: This award is made to honor the author of an outstanding contribution to permanent engineering literature. Permanent literature may be a book or a group of books, or a single paper or group of papers, not less than five years old, which has (or have) been recognized as a noteworthy and permanent contribution to engineering literature.

Spirit of St. Louis Medal: This award is made at three-year intervals for meritorious service in the advancement of aeronautics. It may be given either to a member of the Society or to a member or nonmember of the engineering profession.

ASME George Westinghouse Gold Medal: This award is made for eminent achievement or distinguished service in the power field of mechanical engineering. Using power in the broad sense, basis for the award includes contributions of utilization, application, design, development, research, and the organization and administration of such activities in the power field.

ASME Machine-Tool Design and Economic Value Awards: These awards are given by the National Machine Tool Builders' Association for the best three papers submitted by ASME members on the general subject of machine tools. The papers may deal with problems in design or application of machine tools, their more effective use in reducing production costs or increasing the accuracy of the work done on them, or their economic importance. Each paper should be 2000 words or more in length and the original work of the member who submits it. Each paper may be written by more than one person.

THE GOSS MEMORIAL LIBRARY MOVED TO NEW QUARTERS ON THE PURDUE CAMPUS

(The William F. M. Goss Memorial Library of Engineering History which was recently moved to new, beautiful quarters at Purdue University, is about 25 years old. This historical collection, which today has some 4300 volumes and boasts of rare books dating back to the sixteenth, seventeenth, and eighteenth centuries, has been a boon to the scholars and educators in engineering education. The library is a living memorial to William F. M. Goss, who was president of ASME in 1913.)

People

WALTER L. FLEISHER, Mem. ASME, New York, N. Y., has been nominated to receive the F. Paul Anderson Medal of The American Society of Heating and Ventilating Engineers for 1953. Formal presentation of the award will be made at the society's sixtieth annual meeting in Houston, Texas, Jan. 27, 1954.

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LILLIAN M. GILBRETH, Hon. Mem. ASME, was recently elected an honorary member of The Philippine Association of Mechanical and Electrical Engineers. Dr. Gilbreth is presently on a trip around the world. She spent six weeks in Formosa with the Purdue University Team. Her trip includes visits in India, Madrid, and then on to Rio de Janeiro. She will be in Sao Paulo, where she will attend the tenth International Management Congress, Feb. 19–24, 1954.

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JAMES H. POTTER, Mem. ASME, has been named professor of mechanical engineering and associate dean at Stevens Institute of Technology, Hoboken, N. J., where he will also serve as head of the mechanical-engineering department. Dr. Potter, who was professor of mechanical engineering at the University of Illinois, succeeds RICHARD F. DEIMEL, Mem. ASME, professor emeritus, who retired from active teaching at Stevens in 1952.

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EMANUEL A. SALMA, Mem. ASME, associate professor of mechanical engineering, has been appointed acting director of the Evening Division of New York University's college of engineering.

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WILLIAM R. HEWLETT, vice-president of Hewlett-Packard Company, Palo Alto, Calif., was elected president of the Institute of Radio Engineers for 1954. Other officers elected include: MAURICE J. H. PONTE, director of Compagnie Generale de Telegraphie Sans Fil, Paris, France, vice-president; and directors for the 1954–1956 term, AXEL G. JENSEN, director of television research, Bell Telephone Laboratories, Inc., Murray Hill, N. J.; and GEORGE RAPPAPORT, chief engineer, Countermeasures Branch, Aircraft Radiation Laboratories, Dayton, Ohio.

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ALFRED N. GOLDSMITH, editor of the Institute of Radio Engineers and pioneer in the radio-engineering field, was awarded the IRE Founders Award. Recipients of other awards were also announced as follows: ALDA V. BEDFORD, RCA Laboratories Division, Princeton, N. J., the Vladimir K. Zworykin Television Prize Award for 1954; ROBERT R. WARNECKE, technical director of Compagnie Generale de Telegraphie Sans Fil, Paris, France, the Morris Liebmann Memorial Prize; and HAROLD A. ZAHL, director of research, Signal Corps Engineering Laboratories, Fort Monmouth, N. J., the Harry Diamond Memorial Award for 1954. Presentation of the awards will be made at the annual banquet to be held at the Waldorf-Astoria Hotel, New York, N. Y., March 24, 1954, during the IRE national convention.

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GEORGE E. HOLBROOK, assistant director, development department, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del., was awarded the Professional Progress Award in chemical engineering by the American Institute of Chemical Engineers at the Institute's annual meeting, held in St. Louis, Mo., on Dec. 13 through 16, 1953. Other awards presented at the meeting included the William H. Walker Award for distinguished publication record to WILLIAM R. MARSHALL, JR., professor of chemical engineering, University of Wisconsin; the Junior Member Award for publications by a junior member, LEROY A. BROMLEY, associate professor of chemical engineering, University of California, Berkeley; and the A. McLaren White Award, RAYMOND M. CARTIER, whose paper was judged the best of those submitted in the annual Student Contest sponsored by AIChE.

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PAUL FUGASSI, professor of chemistry at Carnegie Institute of Technology, has been appointed by the Executive Committee of the

trustees to the post of director of the Coal Research Laboratory. The appointment is effective as of Feb. 1, 1954.

* * *

GLENN L. MARTIN, founder and a director of the Glenn L. Martin Company, delivered the seventeenth Wright Brothers Lecture. The lecture, sponsored by the Institute of the Aeronautical Sciences, one of the final events in the year-long celebration of the Fiftieth Anniversary of Powered Flight, was presented on Dec. 17, 1953, in the U. S. Chamber of Commerce Building Auditorium, Washington, D. C. JEROME C. HUNSAKER, Hon. Mem. ASME, professor emeritus of aeronautical engineering, The Massachusetts Institute of Technology, served as lecture chairman.

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DIMITRI SOUSSLOFF, associate director of research, Universal Winding Company, Providence, R. I., received first award amounting to $2981 in the recent National Award Program for welded machine designs sponsored by The James F. Lincoln Arc Welding Foundation of Cleveland, Ohio. The award was one of 77 made by the foundation to engineers and designers in all parts of the country, in its $30,000 Mechanical Design Award Program. The second award of $2682 was given to DAVID W. KINNEY, chief engineer, Pattin Manufacturing Company, Marietta, Ohio. ROBERT J. NEVILLE, vice-president in charge of manufacturing, North American Manufacturing Company, Cleveland, Ohio, received the third award of $2385.

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CHALMERS J. MACKENZIE, president, National Research Council, Ottawa, and director, Canadian Patents and Development, Ltd., has been named recipient of the Kelvin Gold Medal for 1953.

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MORTON O. WITHEY, emeritus dean of the University of Wisconsin college of engineering, was awarded the Citation of Merit of the Wisconsin Utilities Association for his outstanding service to the state, the university, and the engineering profession for almost half a century.

Frequency-Response Symposium

A VOLUME containing the 16 papers prepared by the ASME-IRD Dynamic Systems Committee and presented at the Frequency-Response Symposium held during the 1953 ASME Annual Meeting has been published in a single volume.

The papers are intended for the beginner as well as the frequency-response expert. They cover bibliography, equipment for making frequency-response runs, frequency-response design criteria, and standards for the presentation of data.

Copies of this volume are available and may be purchased from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $5 a copy for nonmembers; $4 for members.

Third UPADI Convention to Be Held in São Paulo, Aug. 3–13

THE Pan-American Federation of Engineering Associations (UPADI) will hold its third convention in Sao Paulo, Brazil, Aug. 3 to 13, 1954. Western Hemisphere engineers chose Sao Paulo for the meeting in honor of the 400th Anniversary of the founding of the city. The time was selected so that engineers might attend both the UPADI Convention and the World Power Conference.

UPADI was organized in 1951 in Havana, Cuba, after a preliminary meeting in Rio de Janeiro in 1949. The second convention in 1952 in New Orleans, La., coincided with the 100th anniversary of the American Society of Civil Engineers and permitted Latin delegates to participate in the observance.

At the Sao Paulo meeting the organization will continue its work on developing standards of practice and professional ethics. Through its Committee on Technical Studies, it will discuss methods of exchanging information on subjects of common interest. But its most important objective will be the establishment of good relations and understanding among engineers of the Americas.

Host for the Convention will be the Brazilian Federation of Engineering Associations of which F. Saturnino de Brito, filho, is president. At the Convention a new slate of officers will be elected to succeed President Luis Giannettassio of Uruguay, who has so successfully guided UPADI in this initial period.

Opportunities will be provided for tours to sites of interest. Many engineers plan to make the complete swing around South America. A large delegation from the United States and Canada is expected to attend.

The American Society of Mechanical Engineers is represented in UPADI through Engineers Joint Council. As a member you may make use of UPADI services. Anyone interested in learning more about UPADI or the Sao Paulo Convention may secure information by writing to UPADI, Box 40, Midtown Station, New York 18, N. Y., giving name, society affiliation, company name and full address, and list the countries you are interested in.

Program of the Convention

August 3

9:00 a.m.—Registration at headquarters of Instituto de Engenharia de São Paulo, Palacio Maua, Viaduto Dona Paulina 80
10:30 a.m.—Preliminary meeting of Convention
5:30 p.m.—Cocktail party
9:00 p.m.—Formal opening of Convention

August 4

9:00 a.m.—Plenary session of Convention
3:00 p.m.—Plenary session of Convention
8:00 p.m.—Committee meetings

August 5

8:00 a.m.—Trip to works of the São Paulo Light and Power Co. at Pinheiros and Cubatao. Visit to the city of Santos

August 6

9:00 a.m.—Committee meetings
3:00 p.m.—Visit to Exhibition in commemoration of 400th Anniversary of founding of São Paulo
5:00 p.m.—Cocktail Party
9:00 p.m.—Committee meetings

August 7

9:00 a.m.—Plenary session of Convention
2:30 p.m.—Visits of technical interest
9:00 p.m.—Closing session of Convention
11:00 p.m.—Grand ball

August 8

9:00 a.m.—Trip to Iguacu Falls between Brazil and Argentina

August 9

At the Falls on Argentine side

August 10–13

Depart for Rio de Janeiro

3:00 p.m.—Sightseeing at Rio de Janeiro
5:00 p.m.—Cocktail party
—Trip to Corcovado Mountain
—Trip to Petropolis and Quitandinha
—Trip across Guanabara Bay to Niteroi

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ASME Calendar of Coming Events

March 10–12, 1954
ASME International Meeting, Hotel Del Prado, Mexico, D. F.
(Final date for submitting papers was Nov. 1, 1953)

March 31–April 1, 1954
ASME Management-Engineering Conference, Benjamin Franklin Hotel, Philadelphia, Pa.
(Final date for submitting papers was Nov. 1, 1953)

June 14–17, 1954
ASME Oil and Gas Power Conference, Hotel Muehlebach, Kansas City, Mo.
(Final date for submitting papers—Feb. 1, 1954)

June, 14–18, 1954
Second U. S. National Congress of Applied Mechanics, University of Michigan, Ann Arbor, Mich.

June 20–24, 1954
ASME Semi-Annual Meeting, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers—Feb. 1, 1954)

Sept. 8–10, 1954
ASME Fall Meeting, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers—May 1, 1954)

Sept. 13–24, 1954
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Commercial Museum and Convention Hall, Philadelphia, Pa.
(Final date for submitting papers—May 1, 1954)

Sept. 26–29, 1954
ASME Petroleum Mechanical-Engineering Conference, Statler Hotel, Los Angeles, Calif.
(Final date for submitting papers—May 1, 1954)

Oct. 28–29, 1954
ASME-AIME Joint Fuels Conference, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers—June 1, 1954)

Nov. 28–Dec. 3, 1954
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1954)
(For Meetings of Other Societies, see page 121)

To ASME Members:

Nominations Open for 1955 Officers

This Is Your Opportunity to HELP

THE 1954 National Nominating Committee of the Society is ready to receive proposals for candidates for the offices to be filled for 1955. It is the obligation, privilege, and responsibility of every member of the Society to assist the Committee in obtaining the best men available. You can do your part by acting as a sponsor for those members who have the acknowledged qualities of outstanding ability and leadership in their profession.

Offices to Be Filled

President	To serve 1 year
Vice-President	To serve 2 years, Region II
Vice-President	To serve 2 years, Region IV
Vice-President	To serve 2 years, Region VI
Vice-President	To serve 2 years, Region VIII
Directors at Large (2)	To serve 4 years
Director at Large (1)	To serve 1 year

Act Now!

Proposals will be welcomed by the Committee.

1 Proposed candidates' names and records should be submitted on the official proposal form which may be obtained from the Secretary of the National Nominating Committee or any of its members listed below.

2 Professional divisions and Boards having to do with the technical work of the Society involved in publications, meeting program, research, standardization, honors, and membership are encouraged to propose candidates.

3 Completed forms should be sent to the Secretary of the National Nominating Committee, Roy C. Robertson, Mechanical-Engineering Department, University of Tennessee, Knoxville 16, Tenn. Proposals for Vice-Presidents are requested in advance of the respective Regional Administrative Committee meetings and proposals for all offices should be submitted before April 1, 1954.

4 The proposer, not the proposed candidate, should fill out the form.

5 Before submitting the name of a proposed candidate, the proposer shall ascertain that the proposed candidate will accept the nomination if tendered.

Members are reminded that in accordance with the Society's Constitution, candidates for office of President, Vice-President, and Director at Large shall be of the grade of Fellow or Member. Members wishing to speak in support of any proposed nominee have the privilege of appearing before the National Nominating Committee at open hearings to be held during the Semi-Annual Meeting in Pittsburgh, Pa., Hotel William Penn, June 21 and 22, 1954.

1954 National Nominating Committee

Region I: A. C. Crownfield, Jr., 138 Clearfield Road, Wethersfield 9, Conn.; L. E. Seeley, *1st Alternate*, College of Technology, University of New Hampshire, Durham, N. H.; Theodore N. Graser, *2nd Alternate*, Cochrane Steam Speciality Co., 80 Federal St., Boston 10, Mass.

Region II: Philip C. Osterman, American Gas Furnace Co., Spring and Lafayette Sts., Elizabeth, N. J.; William S. Johnston, *1st Alternate*, Sanderson & Porter, 52 William St., New York 5, N. Y.

Region III: Samuel B. Sexton, 3rd, Safe Harbor Water Power Corp., Lexington Building, Baltimore 3, Md.; Guerard Mackey, *1st Alternate*, Engineering Department, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.; Charles R. Otto, *2nd Alternate*, Engineering Department, E. I. du Pont de Nemours & Co., Inc., Room 12430, Nemours Building, Wilmington, Del.

Region IV: **Roy C. Robertson, Mechanical-Engineering Department, University of Tennessee, Knoxville, Tenn.

Region V: Ernst W. Allardt, Tubular Products Division, The Babcock & Wilcox Co., 640 E. Keystone St., Alliance, Ohio; Henry N. Muller, Jr., *1st Alternate*, Westinghouse Electric Corp., 401 Liberty Ave., Pittsburgh 30, Pa.; John F. Cunningham, Jr., *2nd Alternate*, Midwest Equipment Co., 545 W. Broad St., Columbus 8, Ohio.

Region VI: *Rolland S. Stover, R. S. Stover Co., 212 Kresge Building, Marshalltown, Iowa; James G. VanVleet, *1st Alternate*, Milwaukee Extension, University of Wisconsin, 623 W. State St., Milwaukee 3, Wis.

Region VII: Sigurd T. Johnson, American Smelting & Refining Co., Garfield, Utah; Bertram G. Dick, *1st Alternate*, Department of the Interior, Bonneville Power Administration, 1300 N. E. Union Ave., Portland, Ore.; Harold A. Johnson, *2nd Alternate*, Mechanical-Engineering Department, University of California, Berkeley 4, Calif.

Region VIII: Carl A. Stevens, 1932 N. Boston Ave., Tulsa 6, Okla.; Richard B. Stewart, *1st Alternate*, Mechanical-Engineering Department, University of Colorado, Boulder, Colo.; H. B. Atherton, *2nd Alternate*, Kansas City Power & Light Co., Postal Station "F," Kansas City 1, Mo.

* Chairman.
** Secretary.

SAO PAULO, BRAZIL, WHERE THE TENTH INTERNATIONAL MANAGEMENT CONGRESS WILL BE HELD ON FEB. 19–24, 1954

Industrial-Management Interest in Tenth International Management Congress Mounting

TOP management within American industry will be well represented at the Tenth International Management Congress to be held in Sao Paulo, Brazil, February 19 through 24, according to a preliminary accounting by the Council for International Progress in Management.

Papers representative of management thinking in eight of the free nations, including the United States, will be formally reviewed by the official U. S. Committee on Papers at a pre-Congress meeting, February 15th, at the Caribe-Hilton in San Juan. The chairman of the Committee on Papers will be, in San Juan, L. C. Morrow, Mem. ASME, director, Editorial Services, McGraw Hill Publishing Company, Inc.

Final Congress registration will be accomplished in Sao Paulo, Brazil, on the 18th of February and H. W. Prentis, Jr., chairman of the Board of the Armstrong Cork Company, Lancaster, Pa., will deliver the keynote speech at the opening session in Sao Paulo on the 19th.

"The Leadership Role of Management" will be the theme of the eight management papers to be presented. Countries presenting papers will be: Belgium, Netherlands, Switzerland, Italy, Sweden, France, United States, and Great Britain.

According to A. M. Lederer, president of CIPM, this Congress to be held appropriately in Sao Paulo, the fastest-growing city in the world, will make public the cream of man's present knowledge of scientific-management principles and methods.

It is also the prediction of CIPM, and her sister organizations in the countries to be represented that this meeting will produce the first steps toward a standardized international-management code of principles that never at any time was in evidence before.

CIPM believes now that enough seeds have been planted abroad to make the Sao Paulo sessions successful. The last International Management Congress was held in Brussels in 1951, at a time when the Marshall plan was in full use. Today that bailing-out period—that period of strenuous U. S. aid—is largely over. So, more than ever before, the problems of promoting vigorous business abroad will fall upon the foreign countries themselves, with the most help coming from an international exchange of management knowledge.

ASME Membership as of Nov. 30, 1953

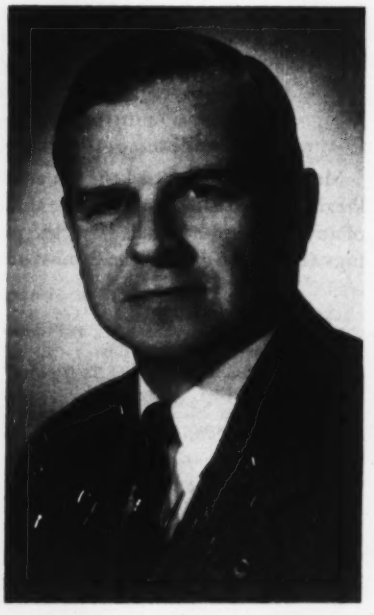
Honorary Members	52
Fellows	380
Members	13,974
Associates	335
Juniors (33 and over)	3,338
Juniors (30–32)	1,989
Juniors (to the age of 29)	18,896
Total	38,964

Louis Polk Appointed ASME Director at Large

LOUIS POLK was appointed to serve as director at large until Nov. 29, 1954, to fill the vacancy caused by the resignation of Paul B. Eaton, now in Formosa as a member of the "Purdue Team" working at the Tainan College of Engineering.

Mr. Polk is president of the Sheffield Corporation, Dayton, Ohio. The company produces precision measuring instruments and machine tools, gages, automatic gaging machines, threading and cutting tools, die heads, collapsible taps, tooling, and contract services. He is also president of the Threadwell Tap & Die Company, Greenfield, Mass., a Sheffield-owned subsidiary, and chairman, The Sheffield Corporation of Australia Pty., Ltd., with plant and general offices at Melbourne.

His other activities include: Director of the Winters National Bank, president of Pirm, Inc., and chairman of the board of directors of the State Fidelity Federal Savings and Loan Association, all of Dayton. He is a national director and vice-president in charge of technical divisions and committees of the American Ordnance Association, as well as chairman of the measurement and standards division and a director and immediate past-president of the Cincinnati Post, A.O.A. He is president of The Sheffield Foundation, an organization which receives and distributes funds for educational, religious, scientific, and charitable purposes. Also, he is a member of the board of directors of the Salvation Army at Dayton.



LOUIS POLK

In addition to the activities already described, Mr. Polk is a director and second vice-president, the National Machine Tool Builders' Association, a member of The American Soci-

ety of Mechanical Engineers since 1943, Society of Automotive Engineers, American Society of Tool Engineers, American Gage Design Committee of the National Bureau of Standards, and a charter member of the Air Force League. He is a permanent director of the Research Fund of the American Society of Tool Engineers.

His membership in clubs includes the Engineers, Bicycle, Moraine Country Club, Miami Valley Hunt and Polo Clubs of Dayton, Metropolitan and Deke Clubs of New York, N. Y., Queen City Club of Cincinnati, Detroit (Mich.) Athletic Club, Bloomfield Hills Country Club, Bloomfield Hills, Mich., and Union League Club of Chicago, Ill.

O. B. Schier Appointed Assistant Secretary ASME

AT THE 1953 Annual Meeting of The American Society of Mechanical Engineers, held in New York, N. Y., Nov. 29–Dec. 4, 1953, Frederick S. Blackall, jr., President of the Society, announced the appointment of O. B. Schier, II, as assistant secretary of the Society.

Mr. Schier has been a member of the ASME Secretary's staff since June, 1946, and his activities with the Society, particularly in connection with the Publications Committee and the Metropolitan Section, date back to the early 1930's.

A native of Baltimore, Md., he received his early education at the Baltimore Polytechnic Institute. In 1929 he was graduated from Lehigh University with the degree of ME, and he received the degree of MS from the same institution in 1931. From 1931 to 1937 he served with the Brooklyn Edison Company as junior engineer, cadet engineer, assistant inventory supervisor, and assistant engineer; and from 1937 to 1941, with the Consolidated Edison Company of New York, Inc., as assistant engineer.

In 1941 Mr. Schier became associated with the War Production Board, Production Service Division, New York, N. Y. As a member of the U. S. Naval Reserve he was attached to the Industry Co-Operation Division, Office of Procurement and Material, Chicago, Ill., from 1943 until his discharge, with the rank of lieutenant in 1946.

Mr. Schier became a Junior Member of ASME in 1932 and was transferred to the grade of Member in 1940. He served the ASME Metropolitan Section as chairman of the Junior Group from 1932 to 1936, and as secretary and member of the Executive Committee of the Section from 1936 to 1940. In 1934 he became an advisory member of the Publications Committee and later was a regular member of the Committee. He was also a member of the Junior Committee of the Committee on Professional Training, Engineers' Council for Professional Development.

As a member of the ASME Staff, which he joined in 1946, Mr. Schier was first appointed secretary to the Professional Divisions Committee. Later he became Meetings Manager and took over the task of operating national meetings and divisional conferences. In October, 1953, he assumed the duties of Field Manager in addition to his former duties as Meetings Manager, supervising office work on meetings and Professional Divisions. As Field Manager he is responsible for the office work related to Sections, Student Branches, Membership, Admissions, and Honors.

O. B. SCHIER, II

Symposium Planned to Honor A. E. White

A SYMPOSIUM on the Utilization of Heat-Resistant Alloys has been announced by the University of Michigan, to be held at Ann Arbor, Mich., March 11 and 12, 1954.

The rapid development of the use of heat-resistant alloys having made such strides over the past several years, the program is designed to present the various aspects of the use of materials at elevated temperatures. It will constitute a review of adaptation of theoretical and practical knowledge to the engineering problems by men who have been part of the rapid developments in the field. There will be ample time and opportunity for discussion.

The symposium will honor Prof. Albert Easton White, Fellow ASME, on the occasion of his retirement from the University, for his pioneering and outstanding contribution to the research and development of alloys for high-temperature service.

The technical program is as follows:

THURSDAY, MARCH 11

Morning Session

General Principles for Utilization of Heat-Resistant Alloys

Creep and Fracture of Metals at Elevated Temperatures, by *N. J. Grant*, associate professor of metallurgy, M.I.T.

Factors Involved in Using High-Temperature Test Data for Selecting Materials and Proportioning Parts, by *Claude L. Clark*, metallurgical engineer, Timken Roller Bearing Co.

Alloys and Their Properties for Elevated-Temperature Service, by *Howard C. Cross* and *W. A. Simmons*, Battelle Memorial Institute

Afternoon Session

Engineering Practice in Design and Selection of Materials for Heat-Resistant Applications

Stress Calculations for Design of Creep Conditions, by *Paul F. Chenea*, assistant dean of engineering and chairman of the department of engineering mechanics, Purdue University

Use of Materials at High Temperatures and Pressures for Steam Power Generation, by *H. A. Wagner* and *J. A. Blecki*, The Detroit Edison Co.

Criteria in the Selection of Materials for Aircraft Gas Turbines, by *H. H. Hanink* and *L. Luini*, Wright Aeronautical Division, Curtiss-Wright Corp.

FRIDAY, MARCH 12

Morning Session

Production and Fabrication Aspects of the Use of Heat-Resistant Alloys

Production and Fabrication of Heat-Resisting Alloys From the Producer's Viewpoint, by *C. T. Evans, Jr.*, Universal-Cyclops Steel Corp.

The Fabrication of High-Temperature-Alloy Steel Piping Suitable for Central-Station and Oil Refinery Service, by *R. W. Emerson*, metallurgist, Pittsburgh Piping and Equipment Co.

Jets—From Blueprint to Engines, by *W. E. Jones, Jr.*, and *A. J. Rosenberg*, Thomson Laboratory, General Electric Co.

Afternoon Session

Metallurgical Variables—Specification and Acceptance Testing

Metallurgical Variables Influencing Properties of Heat-Resistant Alloys, *J. W. Freeman, C. L. Corey*, and *A. I. Rush*, University of Michigan

Development of and Acceptance-Testing Procedures Against Specifications for Heat-Resistant Materials, by *A. W. F. Green*, chief metallurgist, General Motors Corp.

Meetings of Other Societies

Jan. 13

Council for International Progress in Management (U.S.A.), annual meeting and dinner, Plaza Hotel, New York, N. Y.

Jan. 25–27

American Society of Heating and Ventilating Engineers, sixtieth annual meeting, Rice Hotel, Houston, Texas

Jan. 25–28

Plant Maintenance and Engineering Conference, Hotel Conrad Hilton; and Show, International Amphitheatre, Chicago, Ill.

Jan. 25–29

Institute of the Aeronautical Sciences, twenty-second annual meeting, Hotel Astor, New York, N. Y.

Jan. 27–29

Society of Plastics Engineers, international technical conference, Toronto, Ont., Can.

Feb. 3–5

The Society of the Plastics Industry, ninth annual reinforced plastics division conference, Edgewater Beach Hotel, Chicago, Ill.

Feb. 4

The Instrument Society of America, ninth annual regional conference, Hotel Statler, New York, N. Y.

Feb. 19–24

Tenth International Management Congress, São Paulo, Brazil

(*ASME Calendar of Coming Events, see page 118*)

Woman's Auxiliary Has Gay and Busy Program At 1953 Annual Meeting in New York

Mrs. Charles M. Hickox Re-elected for 1954

THE Woman's Auxiliary to the ASME celebrated its Thirtieth Anniversary Meeting in New York, N. Y., coincident with the Annual Meeting, held from Nov. 28 to Dec. 4, 1953. Women's headquarters were in the Sutton Room of the Statler Hotel and over 500 women were registered from all over the country. The Auxiliary continues to grow both in individual and Section membership with total membership now being over 1200 in 17 sections. The newest section is Omaha-Lincoln.

Annual-Meeting Officers

The Officers for the Annual Meeting were: Honorary chairman, Mrs. C. M. Hickox, president of the Auxiliary; general chairman, Mrs. U. A. Rothermel, chairman of the Metropolitan Section; general vice-chairman, Mrs. Crosby Field; treasurer, Mrs. R. W. Oakley; and registrars, Mrs. H. R. Kessler and Mrs. N. W. Wyckoff.

The Metropolitan Section was hostess to the visiting women.

Sunday Reception

The first event of the Annual Meeting was a reception at the Engineering Woman's Club from 4:00 to 7:00 p. m. on Sunday afternoon. The affair, an innovation last year, was repeated this year by popular request and over 200 attended. Albert Sperry of Chicago, Ill., and Benjamin Webb of Philadelphia, Pa., contributed to the festive spirit of the evening with their delightful piano music. Vases of bright chrysanthemums made the Club a charming setting for this affair. Huge bowls of punch and trays of attractive canapes in the various club rooms were enjoyed by those present. During the last hour succulent baked hams and coffee were served in the dining room. Mrs. T. A. Burdick was chairman and Mrs. R. W. Cockrell was vice-chairman.

Registration

A new feature this year was the serving of coffee during the first morning of registration under the direction of Mrs. J. F. Kirby and Mrs. H. R. Adams, in the lounge outside the Ladies' Headquarters. Registration continued until Thursday evening in the Sutton Room, which was also a popular meeting place.

Annual Tea Dance

The Annual Tea Dance was held from 4:00 to 7:00 p.m. in the Georgian Room of the Statler Hotel, with music by Jack Abrams and his orchestra. The tea dance, as always, was a popular event and attended by over 450 persons. Mrs. H. R. Kessler was chairman and Mrs. W. E. Case was vice-chairman. A receiving line of National Officers, some of the National Board, and Metropolitan Section Officers, greeted the guests as they entered. A multicolored chrysanthemum centerpiece was flanked on either side by gleaming silver candelabra on the huge tea table. Fancy sandwiches, attractive pastries, and assorted nuts and mints were served with tea and coffee. Among those who poured were: Mrs. L. K. Sillcox; Mrs. F. S. Blackall, jr., Mrs. O. A. Saunders, Mrs. C. M. Hickox, Mrs. F. W. Miller, Mrs. R. B. Purdy, Mrs. W. E. Karg, and Mrs. E. G. Bailey.

President's Breakfast

Tuesday morning the National Board held an informal buffet breakfast under the chairmanship of Mrs. C. H. Young and Mrs. R. B. Purdy, immediately followed by a National Board Meeting presided over by Mrs. C. M. Hickox, president.

Welcome-Wagon Demonstration

For those who did not attend the National Board Meeting an interesting program was held in the Boston Room of the Statler Hotel under the chairmenship of Mrs. R. W. Cockrell and Mrs. A. C. Foster. This program was a talk and demonstration by Alice Griffen of Welcome Wagon.

Annual Luncheon & Fashion Show

This year the Annual Luncheon was held on Tuesday, December 1, in the Grand Ballroom of the Hotel Pierre. A record crowd of 244 was present. The blue and gold of the Auxiliary was predominant in the decor of the great ballroom. Metal-paper cornucopias were filled with favors donated by various companies: Appointment books by the Cleveland Graphite Bronze Company; pens from Socony-Vaccum Oil Company; pencils from the Coca-Cola Company; sewing kits from Calvert Distillers Corporation; bottle openers from Schenley Distillers, Inc.; Yatrolin Cream from Marian Bialac, Inc.; Ma Griffe Perfume from Carven-Parfum, Inc.; and Camel cigarettes from R. J. Reynolds & Company. Mrs. U. A. Rothermel, general chairman of the Annual Meeting, presided. Honor guests on the dais were Mrs. F. S. Blackall, jr., wife of the retiring president of ASME; Mrs. L. K. Sillcox, wife of the newly elected president of ASME; Mrs. O. A. Saunders of London, England, wife of the representative of The Institute of Mechanical Engineers of Great Britain; Mrs. C. M. Hickox, national president of the Woman's Auxiliary; Mrs. W. E. Karg, first vice-president; Mrs. Thomas E. Purcell, fourth vice-president; Mrs. Elmer R. Kaiser, fifth vice-president; Mrs. John C. Gibb, chairman of the Annual Luncheon, and her two vice-chairman, Mrs. William Byrne and Mrs. J. H. Hochuli, were in charge of the decorations.

After a welcome and introduction of the guests at the head table by Mrs. Rothermel, Mrs. Hickox introduced the chairmen and sponsors of the various sections present who were hostesses at the tables. The meeting was then turned over to Mrs. Gibb who introduced Lola Luxford, fashion director, of the Hotel Pierre, who produced and presented the fashion show, "Yuletide-Hightide," which was a showing of dramatic holiday and resort fashions by noted designers: Gowns by Arnold & Fox; separates by Nelly de Grab and Heatherlane; suits and coats by Willi; theatre gowns by Pauline Trigere; furs by Abe Sussis; hats styled by Jack McConnell for Jurar; jewels by Marcel Boucher; handbags by Ronay, Inc.; and handkerchiefs and scarfs by Carol Stanley, Inc.

Following the fashion show, Mrs. Gibb conducted a drawing for 18 door prizes which consisted of: Handbag by Ronay, Inc.; five bottles of perfume by Lancome Sales, Inc.; four bottles of cologne by Charles of the Ritz; two bottles of perfume by Lorle Parfums; and several other door prizes donated by the Metropolitan Section.

Judging by the attendance and enthusiasm shown, this was one of our finest Annual luncheons.

Mexican Coffee Hour

Tuesday's busy day was complete with a coffee hour in Parlors A, B, and C of the Statler Hotel. During the evening Rita Weldon, soloist, accompanied by Loretta Novotna, entertained with popular and classical selections. Decorations and Mexican hats for the men and roses for the ladies were provided by American Airlines, who also presented two beautiful sound-color travelogs entitled "Viva Mexico" and "Acapulco." These movies featured many places in Mexico to be seen next March by those attending the ASME International Meeting in Mexico City. A high point of the evening was a short talk by Dr. Francisco Villagran, Consul General of Mexico in New York, N. Y. About 200 guests attended. A social hour followed over the coffee cups. Mrs. George W. Nigh was chairman and Mrs. G. E. Hagemann was vice-chairman.

Annual Business Meeting

The Annual Business Meeting of the Auxiliary was held Wednesday forenoon in the Washington Room of the Statler Hotel, with Mrs. Hickox presiding. About 150 attended. Reports were given by the Auxiliary officers, the chairmen of the Standing Committees, and the Section chairmen or their representatives. The Auxiliary has sections in Boston, Buffalo, Chicago, Cleveland, Columbus, Detroit, Fairfield County, Conn., Iowa-Illinois, Lincoln-Omaha, Los Angeles, Milwaukee, Minnesota, New York (Metropolitan), Philadelphia, Pittsburgh, Toledo, and Washington, D. C. All section reports were most interesting and reflected much enthusiasm.

F. S. Blackall, jr., retiring ASME President, visited the meeting and spoke briefly to the women. A short time later R. J. S. Pigott, past-president, escorted L. K. Sillcox, the newly elected president of ASME, into the meeting and introduced him. Mr. Sillcox responded with a greeting to the Woman's Auxiliary.

Mrs. William G. Waltermire, of Cleveland, reported for the tellers of the election, who, with Mrs. Waltermire, included Mrs. N. G. Willen, Metropolitan Section, and Mrs. J. E. Ettorre, Fairfield County Section. The new officers were then introduced. They are: Mrs. C. M. Hickox, president; Mrs. William E. Karg, Philadelphia, first vice-president; Mrs. C. H. Kent, Metropolitan, second vice-president; Mrs. Thomas F. Githens, Cleveland, third vice-president; Mrs. Howard K. Gandelot, Detroit, fourth vice-president; Mrs. W. Bruce McNaughton, Fairfield County, fifth vice-president; Mrs. Milton Gershon, Metropolitan, recording secretary; Mrs. B. W. Taylor, Philadelphia, corresponding secretary; Mrs. William H. Larkin, Metropolitan, treasurer; and Mrs. Gordon R. Hahn, Metropolitan, assistant treasurer.

Mrs. Hickox appointed the following to serve on the Nominating Committee for next year: Mrs. C. Higbee Young, Metropolitan; Mrs. Howard Miller, Cleveland; Mrs. Charles W. Parsons, Chicago; Mrs. W. Walton Forstall, Pittsburgh; and Mrs. R. B. Purdy, Metropolitan.

Tavern-on-the-Green Luncheon

Upon completion of the Annual Business Meeting, Wednesday noon, buses were waiting to transport the women to that delightful, historic restaurant in Central Park, the Tavern-on-the-Green. Christmas greens with red gladioli and candles decorated the tables, giving a holiday air to the occasion. Mrs. R. B. Skinner was chairman and Mrs. Marie Michel was vice-chairman. Favors at each place were through the courtesy of Barricini Candy, Jacqueline Cochrane, Inc., and Western Union. Mrs. Rothermel presided and those seated at the head table were Mrs. Michel, Mrs. Cockrell, Mrs. Oakley, Mrs. Kessler, Mrs. Kent, Mrs. Nigh, Mrs. Burdick, Mrs. Hickox, Mrs. Skinner, and the guest of honor, Mrs. Norman Vincent Peale.

After a brief welcome by Mrs. Rothermel and Mrs. Hickox, Mrs. Skinner introduced the piano team of Edith Fristensky and Loretta Novotna, who played "Slavic Dances," Opus 46, Nos. 1, 10, 8, and 15 by Anton Dvorak. Then followed the high spot of the afternoon when Mrs. Peale spoke to the 130 women present on "Human Engineering." This charming and forceful speaker gave an inspiring talk directed particularly to the wives of engineers. After the talk Mrs. A. C. Foster presented a huge Christmas package to the various hostesses who drew names for nine door prizes which were donated through the courtesy of Gouband of Paris, Inc.; Revlon Products Corporation; Shell Oil Company; and the Metropolitan Section of the Auxiliary. The buses returned the women to the hotel to rest and relax before the Annual Banquet, Wednesday evening. Mrs. C. H. Kent was in charge of transportation.

Brooklyn Navy Yard Tour

Thursday forenoon, buses were again available to take the women to the Officers Club at the Brooklyn Navy Yard where a delicious full-course luncheon was served by Navy personnel. The tables were beautifully decorated with flowers. Mrs. Norman W. Wyckoff was chairman, assisted by Mrs. Walter F. Friend as vice-chairman and with Mrs. Milton Gershon as chairman of transportation.

AT THE ANNUAL LUNCHEON, PIERRE HOTEL

(*Left to right:* Mrs. C. M. Hickox, president, Woman's Auxiliary to the ASME; Mrs. U. A. Rothermel, general chairman; Mrs. Crosby Field, general vice-chairman; and Mrs. John C. Gibb, chairman, Annual Luncheon.)

Seated on the dais were Mrs. Field, Mrs. Kirby, Mrs. Foster, Mrs. Gershon, Mrs. Friend, Admiral & Mrs. William S. Maxwell, Mrs. Wyckoff, Mrs. Rothermel, Lieutenant Commander McIntyre, and Commander Monk. Mrs. Rothermel and Mrs. Hickox gave a few words of farewell at this last event of the 1953 Annual Meeting and thanked the ladies for their co-operation. Mrs. Wyckoff introduced Admiral Maxwell who was instrumental in making this affair possible. He in turn introduced Commander Monk, chief engineer in charge of design at the Brooklyn Navy Yard, who gave a short but interesting talk on the work being done at the Navy Yard.

The 80 women then donned crash helmets and safety glasses and were escorted to Navy buses which took them on a tour of the Navy Yard, past the great machine shops and dry docks, to visit a destroyer and see the quarters, the galley, and the other important points of interest on such a ship. A big treat was the visit to the dry dock where the largest ship in the world is being built, the great new aircraft carrier, *Saratoga*.

Buses returned the women to the Statler Hotel late in the afternoon to complete a busy and interesting week.

The Metropolitan Section of the Woman's Auxiliary to the ASME was happy to be the hostess section for this meeting.

In addition to the various chairmen and vice-chairmen mentioned, the following members of the various committees helped to make possible the smooth running of all the affairs for the women during the Annual Meeting: Mrs. Joseph G. Adiletta, Mrs. H. E. Aldrich, Mrs. M. H. Avram, Mrs. Chris Brous, Mrs. W. E. Caldwell, Mrs. W. W. Clinedinst, Mrs. Sabin Crocker, Mrs. Allan R. Cullimore, Mrs. Adolph Ehbrecht, Mrs. A. M. Feldman, Mrs. P. E. Frank, Mrs. Rudolph F. Gagg, Mrs. Gordon R. Hahn, Mrs. George A. Harman, Mrs. W. Hausmann, Mrs. William H. Larkin, Mrs. Frederick S. Mallette, Mrs. W. Bruce McNaughton, Mrs. Donald V. Minard, Mrs. C. R. Mockridge, Mrs. J. J. Moro-Lin, Mrs. R. M. Nee, Mrs. Erik Oberg, Mrs. E. A. Salma, Mrs. Rudolph Schmidt, Jr., Mrs. E. J. Sharkey, Jr., Mrs. John C. Somers, Mrs. Francis J. Sweeney, and Mrs. N. G. Willen.

ASME Hawaii Section Receives Charter

THE Hawaii Section of The American Society of Mechanical Engineers was presented with their charter on Nov. 17, 1953. The presentation of the charter was made by Alf Hansen, past-chairman of the San Francisco Section during a formal dinner meeting held in the Banyan Room of the Moana Hotel, Honolulu.

Among the unique benefits of ASME membership, Mr. Hansen listed the effective use of Society meetings, publications, contacts, and its many other privileges.

"There are many challenging problems to mechanical engineers," he added. "In the sugar mills alone you have such interesting problems as more efficient heat balance in mill, automatic control of mills and crushers, proper use of bagasse, and by-product developments."

His suggestings to the new section stressed active participation in all Society activities and pointed the importance of starting a Student Branch at the University.

"Take advantage of the many mainland visitors to get good monthly programs and let us on the mainland count on you for a program when you visit us," he said. "Such an exchange of knowledge and ideas help us all keep in touch with all phases of mechanical engineering.

General Henry S. Aurand received the charter thereby officially becoming the first Chairman of the Hawaii Section of The American Society of Mechanical Engineers.

Junior Forum

Conducted by Joseph Schmerler, Assoc. Mem. ASME

"Formal" and "On-the-Job" Training Programs Compared

WHENEVER industry-training programs for young engineers have been discussed the formal type of program has generally been under consideration. The on-the-job type of program remained neglected. For this reason the National Junior Committee sponsored a session at the Annual Meeting devoted to a comparison of the two types of training programs. The two speakers invited to present differing viewpoints are young engineers who completed the types of training programs which each advocates.

The argument for formal training was set out by Duke R. Silvestrini, Assoc. Mem. ASME, sales representative, Allis-Chalmers Manufacturing Company, and the opinion for on-the-job programs was offered by Warren R. Thompson, Assoc. Mem. ASME, United Engineers & Constructors, Inc.

Mr. Silvestrini introduced his comments by pointing out that the fundamental philosophy of the Allis-Chalmers training program is that a man just out of college seldom knows exactly what engineering work he wants to do. Because of his limited experience in school, a graduate actually is not aware of the many different jobs in engineering. Also he may find that the notions of industry he acquired in school are completely wrong. The formal training program is a device for properly locating the new employee in the company structure.

Upon arrival, the trainee is given the usual physical examination, tours, get-acquainted lectures, and a group of psychology tests to determine what his abilities are and where his general interests lie. Then he is assigned to his first location.

It is desirable, for two reasons, that the trainee spend his first few locations in the shops. One reason is that after four or five years of school, most men are a little tired of studying and welcome a change to see how machines are made. Second, it is sad but true, a little learning is still as dangerous a thing as it was to Alexander Pope, and sometimes if a student doesn't try the shops when he first comes with the company, he never gets there. Preferably, the trainee should spend six to nine months in the shops. Each shop location usually lasts about two months.

After shop locations, the trainee goes to the offices where again an attempt is made to move him to the location of his choice. Emphasis is placed on the trainee making the choice of location as far as possible. An application location lasts about four weeks, while the time spent in a design department is from two to three months. Because the trainee is encouraged to select his own locations as far as possible, engineers are found in personnel service, wage analysis, employment office, and other departments not usually thought of as the realm of engineers. Currently, because of the engineering-manpower shortage, it is pointed out that there is greater opportunity in the strictly engineering locations. However, if a man insists that he has the call for a nonengineering location, and an opening is available, he will be placed in the department of his choice.

Jobs in the shop consist mostly of test and assembly, i.e., how does it work, how is it put together?

Application jobs involve taking inquiries from the sales offices, solving customer's problems. On the other hand, design usually means solving the company's engineering problems, developing new machines, and improving existing ones.

A number of lecture courses are available along with application and design locations. They serve to present the over-all story, as well as a brush-up on forgotten technique. Included are an Electrical Lecture Course and similar ones on processing machinery, water conditioning, and the like. They are full-time courses and take from one to six weeks to complete.

The company is always interested in a student's professional development, because it is good for the man and good for the company. Consequently, there is an arrangement made with a local university whereby an interested trainee can obtain a master's degree by attending night school. The company pays one third of the tuition at the start, one third after attaining a bachelor's degree or higher, and the final one third when the master's degree is obtained. For those interested in obtaining a doctorate, fellowships are available. In this manner, advance study is encouraged.

D. R. SILVESTRINI, *standing*, CHECKS THE RECORDS WITH W. R. THOMPSON AT THE JUNIOR MEETING

Sometimes it is said that a disadvantage of the formal training program is that it belongs to the big companies, and a trainee may become "lost" in a big company. However, just the opposite is true because one is never out of touch with the training department. People responsible for the trainee's welfare are not likely to neglect their jobs. Besides, the students weld themselves into a group where lifelong friendships are made.

In conclusion, Mr. Silvestrini said that training starts with recruiting. Selection of the best men is made with an attempt to train them in their chosen field. There is a balance of theory with practicality, shop with slide rule, and hope that the trainees will be socially active as well as scientifically inquisitive.

Mr. Thompson, in his remarks, agreed that the method of initial selection of a candidate for training was much the same in an on-the-job training program as in a formal training program. However, the difference between the two systems of training is immediately evident. The young engineer, in an on-the-job training program, is assigned directly to a supervising designer and put to work. At first, and usually only for a month or so, he is given drafting to do. After he progresses and shows that he has an understanding of drawings and how the individual components fit into the over-all scheme, he is assigned to do engineering studies. This may involve such things as pipe-stress analysis, predicted-performance data, equipment locations, and sizing and routing of pipe and ducts. It is difficult to list each and every project to which the young engineer may be assigned since at any given time the company may be working on a utility power plant, an industrial power plant, a chemical plant or others, any of which has its own particular characteristics and requirements.

The young engineer usually spends from six months to two years on this work, depending upon the construction schedule of each project. When the man shows he is able to handle difficult assignments he is advanced as rapidly as possible. During this time he begins to gain confidence in his ability and sometimes believes that his capabilities are not fully utilized. To find out what these capabilities are, more difficult and involved problems can be assigned to him in general terms and the man left to his own devices to arrive at a good economic solution. Invariably, the complaints disappear and the man begins to realize that he does not know all that he should know on the subject. However, a solution to the problem is worked out since the job must move toward completion.

First Assignments—Construction

On being transferred from the engineering offices to a construction project, an attempt is made to send him to the job on which he did

design. The young engineer is usually first assigned to locating parts that may be spread out over acres of ground or to determine if there is enough material available to start a certain phase of the project.

He may be asked how many men will be required to do a particular job, what special tools will be required, and are they available? He will be asked whether cranes, trucks, or other rigging is required and for the period of time the particular equipment will be tied up on the particular project. As the job progresses, and more and more equipment is put in place, real problems are encountered in getting everything in its proper place. An incorrect answer could be expensive, not only in money, but in lost time.

As the construction project nears completion the young engineer may be required to check the location of pumps, piping, control systems, both electrical and pneumatic, to determine if the correct connections have been made. He may also be required to supervise the various tests such as rotation of motors, hydrostatic tests, and electrical-insulation tests.

The young engineer is almost invariably called upon to render assistance during the preliminary operation of the plant to see that the proper sequence of operation is observed and that all controls are functioning properly. It is during this period that he will find himself wishing that he were twins. Finally the day arrives when the preliminary operation has been completed and the plant is going into commercial production. Then he becomes involved in the exacting task of performance tests and the final checks and adjustments that are invariably required.

Continuing Instruction and Training

This process of introducing the college graduate to his first engineering and construction assignments may last anywhere from one-and-one-half to four years, depending upon the size and construction schedule of each job. From the beginning of employment the man has been assigned to active jobs and after the first month or so has been required to pull his full weight. It is recognized throughout this period that the man lacks experience and, in some cases, the technical background to handle jobs independently of supervision. It is felt, however, that placing as much responsibility on the young man as possible will, under proper supervision, mature an engineer more rapidly than would a system of formal instruction and observation.

ASME Standards Workshop

Interpretation of Code for Pressure Piping

FROM time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinion of the committee.

Pending revision of the Code for Pressure Piping, ASA B31.1–1951, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. The following cases are published herewith as interim actions of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

Case No. 12 (Reopened)

Inquiry: Is it permissible to use material conforming to the ASTM emergency alternate provisions for phosphorus and molybdenum, viz., ASTM EA-335?

Reply: It is the opinion of the committee that material may be used in accordance with the emergency alternate provisions with no change in allowable stresses.

Case No. 14

Inquiry: May straight-threaded couplings be used with Schedule 40 or standard weight threaded pipe in sizes 2 in. and smaller?

Reply: It is the opinion of the committee that straight-threaded couplings may be used on nonnoxious fluids with Schedule 40 or standard weight pipe in sizes 2 in. and smaller provided the fluid pressure does not exceed 150 psig and the temperature does not exceed 500 F. This applies to Sections 1, 3, 4, and 5 of the Code for Pressure Piping, but not to Section 2.

Actions of the ASME Council

At 1953 Annual Meeting, Hotel Statler, New York, Nov. 29-30, 1953

THREE sessions of the 1953 Council of The American Society of Mechanical Engineers were held at the Hotel Statler, New York, N. Y., Nov. 29 and 30, 1953, in connection with the 1953 ASME Annual Meeting. President Frederick S. Blackall, jr., presided.

Louis Polk, Director at Large

Louis Polk, appointed to serve as director at large until Nov. 29, 1954, to fill the vacancy caused by the resignation of Paul B. Eaton, now in Formosa, was introduced. Professor Eaton, in a letter to the President, said that his resignation was dictated by his appointment to serve as a member of "The Purdue Team" under contract between Tainan College of Engineering and Purdue University through FOA "to aid in the development of the college and to bring about a more rapid rise in the economy of the Island."

Annual Reports

The annual report of the Council (see pages 54–59) was adopted; and the reports of the Boards, Committees, and representatives on joint activities were accepted. The annual and financial reports of the Woman's Auxiliary were received with an expression of deep appreciation and gratitude for the fine achievements of the Auxiliary during the year.

Constitution and By-Laws

The Secretary announced member-ballot approval of changes in the Constitution relating to membership grades; the effect of the changes is to substitute Associate Member grade for the present Junior Member grade, and Affiliate for the present Associate grade. (These changes were made as a result of recommendations of Engineers' Council for Professional Development in an effort to secure the adoption of a uniform designation of membership grades by its constituent societies.) The changes went into effect at the Business Meeting, Nov. 30, 1953.

The Council adopted certain amendments to the By-Laws necessitated by the changes of membership-grade designations; others, relating to the Board on Technology, occasioned by the reorganization of the ASME research activities; and a rewording of the By-Law relating to the Publications Committee, defining its authority in less general terms. The Council received for first reading a rewording of Article B6A, Par. 19-A, made necessary by renaming the Engineers Civic Responsibility Committee the Civic Affairs Committee.

Publications Committee

On recommendation of the Board on Technology the Council approved a special report of the Publications Committee, dated June 17, 1953. Briefly, the report recommended:

1 Free distribution of ten preprints of papers by the coupon method. (This recommendation, in modified form, was put into effect by the Executive Committee of the Council in July, 1953).

2 Transactions and *Journal of Applied Mechanics* to be continued on a subscription basis.

3 A study to determine the feasibility of again grouping material of related divisions for Transactions. (This study is now in progress.)

4 Appointment of a committee of review, acting for and reporting to the Publications Committee, to read and recommend which papers should preferably be published.

5 That an effort be made to overcome within the membership any feeling "that we are limited in our professional interests."

Free-Coupon Scheme

The Secretary read a report on the results of the action of the Executive Committee authorizing him "to distribute to each member with his bill for dues for 1953–1954, ten coupons which can be used to secure preprints of papers." (The report showed that as of Nov.

An Agreement

between

The American Institute of Electrical Engineers

and

The American Society of Mechanical Engineers

September 28, 1953

THE Council of The American Society of Mechanical Engineers and the Board of Directors of the American Institute of Electrical Engineers by identical action have agreed upon a provision by which a member of one of the two Societies may become a member of the other without payment of initiation or entrance fee in the second Society. In each case, the member of the first Society must present his application for membership in the second Society and meet the membership requirements of the second Society.

THE elimination of entrance fee in the second Society shall apply only to the fee for entrance at the equivalent or lower grade. If an applicant to the second Society is upgraded by the second Society, his promotion fee shall be paid to the second Society. The Fellow grade in each Society is upon nomination or invitation.

EACH Society permits a Student Member, upon graduation to become a member of the Society in a suitable grade without entrance fee. By this agreement, a student who has transferred to the suitable grade in his Society may apply for entrance in a suitable grade in the second Society and upon acceptance, may take the grade without entrance fee.

This Joint Agreement is in effect January 1, 1954

Approved by the Board of Directors of AIEE — November 5, 1953

PRESIDENT AIEE

SECRETARY AIEE

Approved by the Council of ASME — November 19, 1953

PRESIDENT ASME

SECRETARY ASME

AIEE-ASME AGREEMENT

(Facsimile of the AIEE-ASME Agreement which provides a means by which a member of one of two societies may become a member of the other without payment of an initiation or entrance fee in the second Society.)

24, 1953, approximately 2475 members submitted coupons for 10,387 copies of papers of which 934, or 9 per cent, were unavailable. The report commented on some of the problems encountered in operation of the scheme and concluded with the statement, "the costs of the new scheme are as yet uncertain." Consideration of the report was referred to the vice-presidents at their meeting to be held in New York on Feb. 12, 1954.

75th Anniversary Celebration

The Council approved a progress report on the 75th Anniversary Celebration and the organization of committees set up in connection therewith and directed the 75th Anniversary Committee to report directly to the Council rather than through the Board on Technology.

Reciprocal Fees, AIEE

The Council authorized the President and Secretary to sign the agreement with the American Institute of Electrical Engineers which provides a means by which a member of one of the two societies may become a member of the other without payment of an initiation or entrance fee in the second Society. (A facsimile of this agreement appears on this page.)

Power Test Codes and Boiler Code

Approval was voted of extending for one year the terms of A. G. Christie, as chairman of the Power Test Codes Committee, and of H. B. Oatley, as chairman of the Boiler Code Committee.

Changes in Organization of the Council

A statement on Proposed Changes in Council Organization, submitted by the Organization Committee, received extended discussion. (The proposed changes were also discussed at the meeting on Sunday evening of members of the Council and Committees, see pages 73–77, and by the President in his address at the luncheon on Monday, see page 80.) The purpose of the proposed changes, it was explained, is an attempt to effectuate real representation of the diverse activities of the Society. A series of actions followed:

(*a*) The statement was referred back to the Organization Committee and to the Constitution and By-Laws Committee jointly for further study and preparation of a statement for presentation to the Council for final approval and to the next Business Meeting of the Society.

(*b*) An expression of confidence was given to the Organization Committee.

(*c*) It was agreed that any plan set up should provide for some degree of representation of the Professional Divisions, Codes and Standards, and administrative committees on the Council.

(*d*) The Nominating Committee should feel free to nominate anyone but should receive suggestions for the various activities of the Society.

(*e*) The chairman or representative of the Organization Committee and the Secretary should attend the Professional Divisions Executive Conference, Jan. 7 and 8, 1954, to discuss the proposal on reorganization of the Council.

(*f*) The Organization Committee was requested to delete the provision that one of the three additional members of the Nominating Committee be selected by the Council.

(*g*) One of the three additional members of the Nominating Committee should be selected from the other administrative committees.

(*h*) The Organization Committee was asked to reconsider the matter of Council reorganization and submit recommendations to the Council by May 1, 1954.

Publication of Council Policies

The Council voted to authorize annually the collection of all policies adopted by the Council during the year, this collection to be reviewed each year by the Constitution and By-Laws Committee and determination made as to publication of the policies in pertinent manuals and as to inclusion of necessary references in the index to the Constitution, By-Laws, and Rules.

Pension Committee

A report of the Pension Committee was referred to the Finance Committee to make recommendations on the adoption of all or part of the recommendations of the report.

Sections

Authorization was voted of disbandment of the Peninsula Section (Michigan), effective Dec. 7, 1953. Calhoun and Branch Counties are reassigned to Central Michigan Subsection of the Detroit Section.

Authorization was voted of the establishment of the Peninsula Subsection of the Virginia Section; the area to include the City of Newport News, City of Warwick, City of Hampton, James City County, and York County.

Authorization was voted of the establishment of the Saginaw Valley Subsection of the Detroit Section to include the Counties of Bay, Midland, and Saginaw in Michigan.

The status of the Albuquerque Subsection was changed to that of a full Section, to be known as the New Mexico Section and to include all members in the State of New Mexico.

1953 Regional Delegates Conference

The statements and actions on the recommendations of the 1953 Regional Delegates Conference were adopted.

New Engineering Societies Building

R. F. Gagg, ASME Representative on United Engineering Trustees, Inc., and President of that body for 1952–1953, presented a report on the plans under way for a new Engineering Societies Building, to be established in New York or in some other city to be determined later. He pointed out that the expansion of engineering activities of the four Founder Societies since the erection of the present headquarters nearly fifty years ago has long since made the building inadequate, and clearly it is imperative that a modern home for the professional engineering societies be established. The present building cannot economically be altered to meet the requirements. The Trustees have studied carefully several means suggested for acquisition of a modern home for the engineering societies and have considered various locations in Baltimore, Chicago, Cleveland, Detroit, Washington, Pittsburgh, and New York.

Mr. Gagg asked the Council to state its desire and intent so he may be guided accordingly in representing the Society on UET.

The Real Estate Committee of UET met on Nov. 23, 1953, and developed a "Declaration of Intent" for transmission to the respective societies of UET and to such other educational and scientific societies as UET may select. After discussion, the Council voted: To adopt the "Declaration of Intent" drawn up by the United Engineering Trustees, Inc., as follows: "To promote the interest of its members, and to achieve increased unity among engineers The American Society of Mechanical Engineers declares its intent to continue with the Societies now comprising UET and with other educational and scientific engineering organizations for the purpose of acquiring and operating a National Engineering Center at such a location as may be agreed upon as desirable."

The Council discussed thoroughly the factors involved if the new Engineering Societies Building were established in a city outside of New York. It was believed that this was a matter of major importance involving a departure from usual custom and therefore submission to the membership for decision by letter ballot was in order. It was felt, however, that the final decision as to location should be the responsibility of the Council, and therefore, Council voted: That a letter ballot be submitted to the membership on which the following question should be asked: "Do you approve vesting in the Council the authority to decide for The American Society of Mechanical Engineers, at such time and place and in such manner as the Council may elect, such changes, if any, in Society headquarters' location as the Council may deem to be to the best interest of the Society and in keeping with its dignity and traditions?"

ASME Staff

The Council voted to extend to George A. Stetson, Mildred Heins, Charles E. Bregenzer, and Gurney A. Rickert, members of the Staff for 25 years, sincere appreciation of their loyal services and contributions to the work of the Society.

The Secretary presented Walter E. Letroadec, who became associated with the Society on Aug. 4, 1953, as office manager.

Arthur M. Greene, Jr., Legacy

The Secretary reported that a legacy had had been left to the Society by Arthur M. Greene, Jr., Honorary Member, who died on Sept. 2, 1953.

Certificates of Award and Appointments

Certificates of Award were voted to several retiring chairmen of Professional Divisions, Sections, Regional Committees, and to John F. Barclay, who served as chairman of the Model Smoke Law Committee of the Fuels Division over a period of years. Approval was voted of appointments on Committees and Joint Activities. The following presidential appointments were confirmed: Inauguration of the Rector, The Catholic University of America, Washington, D. C., Nov. 19, 1953, E. H. Hanhart; Third International Congress of Mechanical and Electrical Engineers, Mexico, Nov. 30–Dec. 4, 1953, George D. Camp.

Harvey F. Mack

The Council asked the Secretary to extend their congratulations to Harvey F. Mack, president, Mack Printing Company, Easton, Pa., on his seventy-fifth birthday, Nov. 7, 1953. The Mack Printing Company has printed the Society publications since 1921.

Organization Meeting of the 1954 Council

THE organization meeting of the 1954 Council was held on Nov. 30, 1953, following a dinner at the Hotel Statler, New York, N. Y. Mr. Blackall, retiring president, called the meeting to order and introduced the new and re-elected members of the Council. He then presented the "President's Gavel" to Lewis K. Sillcox, President, 1954, who took the chair.

Certificates of Award

Certificates were presented to E. G. Bailey, past-president; E. H. Hanhart, E. S. Theiss, and S. H. Graf, vice-presidents; and B. P. Graves and T. E. Purcell (in absentia), directors at large.

Past-President R. J. S. Pigott presented the special President's emblem to Mr. Blackall on behalf of the Council, which voted an expression of their appreciation to the retiring President for his achievements during the 1952–1953 administrative year.

Appointments

C. E. Davies was appointed Secretary and O. B. Schier, II, assistant secretary for terms of one year. Joseph L. Kopf was appointed Treasurer of the Society and of the Development Fund and Edgar J. Kates was appointed Assistant Treasurer of the Society for one year.

Executive Committee

Upon nomination of the President, the Executive Committee of the Council was appointed, as follows: Lewis K. Sillcox, chairman; Willis F. Thompson, Thompson Chandler, Harold E. Martin, and Albert C. Pasini.

Assignment of Directors

The following assignments were made of Directors at Large to the Boards and Committees: Codes and Standards, Louis Polk; Education and Professional Status, R. L. Goetzenberger; Honors, L. J. Cucullu; Membership, D. W. R. Morgan; Public Affairs, R. B. Lea; Technology, A. C. Pasini; Finance Committee, H. E. Martin; Organization Committee, F. L. Bradley; R. J. S. Pigott, (Past-President).

Council Committee on Staff Personnel

The Council Committee on Staff Personnel for 1954 was appointed as follows: J. M. Todd, chairman; W. F. Thompson, H. E. Martin, D. W. R. Morgan, and A. C. Pasini.

Engineers Joint Council

Representatives of ASME to serve on Engineers Joint Council and on EJC Committees for 1954 were appointed as follows: EJC representatives; R. J. S. Pigott, R. L. Goetzenberger, F. S. Blackall, jr., and C. E. Davies, with E. J. Kates, D. W. R. Morgan, and Thompson Chandler, as alternates; EJC Committee members: National Engineers, R. L. Goetzenberger; Engineering Sciences, K. H. Condit; International Relations, Joseph Pope, J. W. Cox, and George Browne; Constitution and By-Laws, E. J. Kates; National Water Policy Panel, W. F. Uhl; Special Surveys, H. N. Muller, Jr.; Atomic Energy Panel, Walker L. Cisler; and Labor Legislation Panel, W. F. Ryan.

Special Committees

Upon recommendation of the Organization Committee the Council voted continuance of certain special committees.

Delegation of Functions

Delegation of specific functions was voted to the Board on Technology and the Board on Codes and Standards.

Public Relations

The Council voted to rescind action taken at the Los Angeles Meeting, June 28–29, 1953, whereby responsibility of public relations was placed under the Board on Public Affairs, and requested the Executive Committee to give consideration to the problem at a meeting which was called for Dec. 28, 1953.

Literature

Electric Utilities

THE 1952 edition of "Statistics of Electric Utilities in the United States," is now available. This publication presents comprehensive financial and operating information on every important privately owned electric utility in the United States. It is published by the Federal Power Commission. The new edition contains detailed financial and operating information in the form of schedules consisting of balance sheets, income and earned surplus statements, capital stock, and long-term debt; electric-operating revenues; customers and sales by classes of service; electric operating expenses; utility plant; and physical quantities. The 424-page report also contains comparative financial statements for the industry as a whole for the years 1942 through 1952. Copies may be obtained from the Publications Division, Federal Power Commission, Washington 25, D. C., at $5 per copy.

Industrial Water

THE American Society for Testing Materials has recently published a "Symposium on Continuous Analysis of Industrial Water and Industrial Waste Water." The 54-page booklet contains five papers with discussion, which were presented at the Seventh and Eleventh Sessions of the fifty-fifth annual meeting of the ASTM held in New York, N. Y., June 24, 1952. The papers include "Automatic Sampling of Industrial Water and Industrial Waste Water;" "Measurement of Color, Turbidity, Hardness, and Silica in Industrial Waters;" and "Continuous Measurement of Dissolved Gases in Water." Copies of the symposium may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pa. Cost is $1.50.

Industrial Engineering Institute

THE Proceedings of the fifth annual Industrial Engineering Institute held at the University of California, Berkeley, Calif., Jan. 30–31, 1953, and at Los Angeles, Calif., Feb. 2–3, 1953, are now available. The 120-page booklet contains 23 papers with discussion. Some of the subjects covered include job evaluation, the future of industrial engineering, the application of operations research to industry, industrial engineering, planning and control for small manufacturing plants, and a statistical analysis of visual inspection methods. Copies may be obtained from the Elliott Printing Company, 1016 Jackson St., Oakland, Calif. Cost per copy is $3.50.

Heat Transfer and Fluid Mechanics Institute

PAPERS presented at the 1953 Heat Transfer and Fluid Mechanics Institute held June 30-July 2, 1953, at the University of Southern California, Los Angeles, Calif., in conjunction with the 1953 ASME Semi-Annual Meeting, have recently been published in one volume. The 1953 Institute was the sixth of a series initiated in 1948 for the purpose of making available to engineers a program of high scientific caliber representing fundamental contributions to the engineering sciences. Papers published in the 1953 volume consist of 16 discussions of the latest scientific contributions of research and development centers throughout the United States. The 240-page, paper-bound volume contains papers on the following subjects: Heat transfer in the compressible turbulent boundary layer on a flat plate, a study of shock-wave turbulent boundary-layer interaction, free convection in electric fields, heat transfer associated with nucleate boiling, and open-channel flow of water-air mixture. Copies may be obtained from the Stanford University Press, Stanford, Calif. Cost of each copy is $5.50.

Engineering Periodicals

A RECOMMENDED List of Basic Periodicals in Engineering and the Engineering Sciences has been published by the Association of College and Reference Libraries. The 42-page booklet was prepared by a special committee of the ACRL Pure and Applied Science Section. It contains both an alphabetical and a classified list of 553 recommended basic periodicals in engineering and the engineering sciences. The classified list is separated into 12 different types of engineering including ceramic, agricultural, and architectural engineering. The booklet also contains an alphabetical list of abstracting journals, indexes, and other sources. Copies may be obtained from ACRL Monographs, c/o University of Illinois Library, Chicago Undergraduate Division, Chicago, Ill., at 75 cents each.

Coming Meetings

High-Speed Computer

A HIGH-SPEED Computer Conference will be held on the campus of the Louisiana State University, January 28–30, 1954. This is the first time that a conference of this kind has been held in the South.

This conference is being sponsored by the University in co-operation with a number of business, accounting, research, and engineering organizations interested in high-speed computers. The purpose of the conference is to discuss the uses and applications of high-speed computers in business-office procedures, statistical operations, and scientific and technical analyses.

On exhibit during the three-day meeting will be electronic and other high-speed computing devices and equipment. Scheduled on the program will be speakers prominent in the field of high-speed machinery. A registration fee will be charged.

Those desiring more detailed information should write directly to Dr. Leon Megginson, care of Louisiana State University, Baton Rouge, La.

Industrial Engineering

THE sixth annual Industrial Engineering Institute of the University of California will be held in Berkeley on January 29 and 30 and in Los Angeles on February 1 and 2, 1954.

The purpose of this annual conference is to present fundamentals and recent practical applications in the field of industrial engineering and management, as well as the results of industrial-engineering research performed at the University and throughout the country.

This year's conference will include sessions on the following topics: Industrial Engineering in Small Business, Human Factors in Engineering Design, Office-Work Simplification, Tool Engineering and the Selection of Manufacturing Processes, Small-Business Organization and Management, Human-Engineering and Industrial Psychology, Recent Developments in Production-Engineering Techniques, Design Changes and Lower Production Costs, and Recent Results of Industrial-Engineering Research.

The Institute is presented in co-operation with the American Institute of Industrial Engineers, The American Society of Mechanical Engineers, Society for Advancement of Management, American Society for Quality Control, The Society of Applied Industrial Engineers, and American Material Handling Society. Printed Proceedings of the conference will be distributed to those in attendance.

Computers

THE second annual Western Computer Conference and Exhibit sponsored by The Joint American Institute of Electrical Engineers, Institute of Radio Engineers, and Association for Computing Machines Computer Conference Committee will be held at the Ambassador Hotel in Los Angeles on Feb. 11 and 12, 1954. This conference is composed of two parallel sessions, one on control systems and one on data-processing systems. These sessions will be of wide general interest to engineers and businessmen. One feature of the data-processing session will be the presentation of how a problem, as presented by the controller of one of the largest Los Angeles, Calif., department stores, can be solved with electronic digital-computing techniques.

The exhibit will demonstrate the latest electronic computing machines capable of solving problems in a few minutes, which formerly required days. This exhibit of electronic geniuses is open to the public and there is no charge for admission.

Pressed Metal

THE 1954 annual spring technical meeting of the Pressed Metal Institute will take place at the Hotel Carter in Cleveland, Ohio, March 17 through March 19, 1954.

Subjects to be discussed during the technical sessions on March 18 and 19 include: In-process material handling and resistance welding. Those in attendance will also have an opportunity to visit three prominent plants in the Cleveland area.

Safety in a stamping plant will be the theme of the first day's meeting. The 1953 Technical Meeting inaugurated the safety program and its success has encouraged PMI's Technical Research and Standards Committee to annually expand the meeting to a three-day session with

the first day dedicated to accident reduction in the metal-stamping industry.

Industrial Ventilation

THE first three-day Industrial Ventilation Conference sponsored jointly by the New York State Labor Department's Division of Industrial Hygiene, and Syracuse University, will be held at the University's Maxwell Hall on Feb. 1–3, 1954. The purpose of the conference is to bring to the attention of engineers and safety and industrial-hygiene personnel the latest information on the design of industrial exhaust systems.

The topics of the lectures include the value of industrial hygiene to industry and labor; New York State codes applying to the control of dust, gases, and fumes; fundamentals of fluid flow applied to piping and fittings; principles of hood design; types of dust collectors; fan type and selection; methods of sampling air for solid, gaseous, and vapor contaminants; air-flow measurements of exhaust systems; and other methods for industrial-hygiene control of atmospheric contaminants.

A nominal registration fee will be charged to cover the cost of tuition and materials. Applications and requests for additional information should be addressed to Miss Eleanor Ludwig, Co-Ordinator of Conferences, University College, 601 E. Genesee Street, Syracuse, N. Y.

Education

Barium Steel Fellowships

THE Barium Steel Corporation announced the establishment of three graduate fellowships for advanced studies in engineering. Grants for one-year graduate fellowships will be made annually to Massachusetts Institute of Technology in mechanical engineering, the University of Pennsylvania in metallurgy, and Case Institute of Technology in electrical engineering.

Richard T. Salter, a senior in the honors course in mechanical engineering at M.I.T., has been named as the first recipient.

G-E Fellowships

THE nation's top college graduates will be able to further their studies this year under research grants to be made from the multi-million-dollar General Electric Educational and Charitable Fund.

For the thirtieth consecutive year, applications are being accepted from graduates of United States colleges and universities for the fellowships to be awarded for the 1954–1955 academic year. Granted in honor of Charles A. Coffin and Gerard Swope, both former presidents of G.E., the fellowships are for study in the fields of the physical sciences, engineering, and industrial management. The fellowships are not intended for graduates who now hold, or expect to hold, any other fellowships. The grants are for college graduates who need financial assistance and who have shown by the character of their work that they could, with advantage, undertake or continue research in this country.

Applications for the fellowships must be filed by January 15, 1954, and mailed to the Manager, Educational Relations, General Electric Company, Schenectady, N. Y.

A committee representing the National Academy of Sciences, American Chemical Society, American Physical Society, The American Society of Mechanical Engineers, American Institute of Electrical Engineers, and the American Society for Engineering Education, will select the 1954–1955 fellows.

Plastics Fellowships

PRINCETON University has announced an engineering curriculum of graduate study and fundamental research in plastics leading to the degree of master of science in engineering; particularly suited to chemical, electrical, and mechanical engineers, and to chemists and physicists.

Instruction covers properties, evaluation, production, fabrication, design and application of materials, as well as chemistry of plastics. Program includes lecture and laboratory classes and contact with industrial plants representing various interests of the plastics industry.

Fellowships with stipends of from $1500 to $2100 plus tuition and fees are available. Opportunities for employment as half-time research assistants at $1500 per academic year are also available to students not on fellowships.

Applicants for admission must hold a bachelor's degree in engineering or physical science from a recognized institution and must meet general admission requirements of the Graduate School of Princeton University.

For further information regarding curriculum, fellowships, research assistantships, and application forms, address: Louis F. Rahm, Director, Plastics Laboratory, 30 Charlton Street, Princeton, N. J.

Statistics

DURING the spring quarter of 1954 (March 24 to June 4) the Institute of Statistics of the University of North Carolina will sponsor a special program of course work, lectures, and seminars on statistics for research engineers, physicists, and chemists. The primary objective of this program is to provide an opportunity for industrial-research workers to acquire a working knowledge of modern statistical concepts and techniques. Emphasis will be on the efficient design of experiments and the analysis of data therefrom. Informal seminars on statistical problems submitted by the participating students will be held. Regular college credit will be granted for course work satisfactorily completed. For further information write to Institute of Statistics, North Carolina State College, Box 5457, Raleigh, N. C.

New Mechanics Courses

TWO new evening courses in mechanics will be offered for the first time by Illinois Institute of Technology, Chicago, Ill., during the spring semester, beginning Feb. 15, 1954.

A four-credit course giving an introduction to the theory of elasticity will cover general equilibrium relations and the stress-strain relations for homogeneous, isotropic, and elastic materials with applications to plane problems.

The other course on the theory of plasticity will discuss yield conditions, stress-strain relations in the plastic range, simple trusses and beams, torsion and cylindrical or prismatic bars, problems in plane strain, and introduction to Cartesian tensors and extremum principles. It will be a three-credit course.

Evening division classes are held on the Illinois Tech campus, 33rd and State Streets. Registration will be held Feb. 8 and 9.

Corrosion

PROGRAM plans for the 1954 annual short course in corrosion held by the National Association of Corrosion Engineers are well under way. The five-day course to be held on the campus of Washington State College at Pullman, Wash., Feb. 1–5, 1954, will present a brief but intensive review of the fundamental aspects of corrosion followed by panel discussions and lectures on the applications of corrosion control in industry. The Division of Industrial Services of the Washington State Institute of Technology is the college sponsor of the course.

The program includes five general topics—fundamentals, practical aspects, corrosion mitigation, materials of construction, and environment.

For further information address requests to Prof. E. B. Parker, Director, Division of Industrial Services, State College of Washington, Pullman, Wash.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Jan. 25, 1954, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

NEW APPLICATIONS

For Member, Affiliate, or Associate Member

ACKER, WILLIAM L., Scranton, Pa.
ADAMS, EDWARD T., Johnson City, N. Y.
ADAMS, RICHARD F., Alton, Ill.
ALI, CH. ZULFIQAR, Lahore, Pakistan
ALLEN, BONNELL H., Chicago, Ill.
ANDERSON, STEWART A., Singapore, British Malaya
APPLIN, RONALD, London, England
ARTHUR, BRYAN E., JR., Albuquerque, N. Mex.
BARNARD, GEORGE H., Schenectady, N. Y.
BATSON, HORACE F., Portsmouth, Ohio

BAUDISTEL, HERBERT H., JR., Los Angeles, Calif.
BAYLESS, FRANK K., Cleveland, Ohio
BAYLOR, WALTER R., Mt. Rainier, Md.
BLAKE, CHARLES T., Cleveland, Ohio
BROWN, WESTON A., Massapequa, N. Y.
BRULL, MAURICE A., Ann Arbor, Mich.
BUESS, RICHARD A., Chicago, Ill.
BURT, ROBERT V., Cincinnati, Ohio
CAIN, DAN L., Oak Ridge, Tenn.
CAMERON, JOSEPH A., Greensburg, Pa.
CARLSON, ROY F., Dallas, Texas
CASCI, RENATO A., Ridgewood, N. J.
CATHER, HAROLD D., Morgantown, W. Va.
CEROKE, CLARENCE J., Chicago, Ill.
CHAPMAN, WILLIAM J., Birmingham, Mich.
CHATENET, RENE R., Paris, France
CHATURVEDI, UMA PATI, Kanpur, U. P., India
CHEN YU, Detroit, Mich.
CHOURZAMANIS, ANTHONY, New York, N. Y.
COLLMAN, JOHN S., Detroit, Mich.
CRAFT, JAMES W., Los Angeles, Calif.
CURRY, ROBERT F., Livonia, Mich.
CURTISS, HOWARD C., JR., Erie, Pa.
DALLAS, ROBERT W., Buffalo, N. Y.
DENGLE, SYDNEY H., Newton, Iowa
DICKEY, STEPHEN W., New York, N. Y.
DUNN, EDWARD A., Springfield, Mass.
EBERTH, PETER J., Montreal, P. Q., Can.
ENGERISSER, WILLIAM F., Bethpage, N. Y.
ENOS, RICHARD C., Sweetwater, Texas
EVANS, P. WILSON, Chicago, Ill.
FEICHTMANN, HOWARD J., Milwaukee, Wis.
FERREIRA, LUIZ A., São Paulo, Brazil
FILARDI, ANTHONY, Bayside, N. Y.
FINLEY, KARL L., Ashland, Ohio
FOX, JOHN C., Richland, Wash.
FRIEDMAN, RICHARD M., San Francisco, Calif.
FRY, JESS L., Denver, Colo.
FRYZELKA, LOUIS G., Toledo, Ohio
FULCHER, JOHN E., Union City, N. J.
GALLETLY, GERARD D., Alexandria, Va.
GARNER, KENNETH B., Chattanooga, Tenn.
GEYER, HELMUT W., Los Angeles, Calif.
GHOSH, NIRMAL K., Wolverhampton, England
GIBSON, RALPH W., Seattle, Wash.
GOLDBERG, ARNOLD, Suffern, N. Y.
GORDON, ROY H., Brooklyn, N. Y.
GREASER, WILLIAM J., New York, N. Y.
GREGORY, LEONARD D., La Canada, Calif.
GRIFFEL, MARC R., Burlington, Iowa
HALLDEN, KARL W., Thomaston, Conn.
HAMRED, MUHAMMAD A., Gujranwala, West Punjab, Pakistan
HAMER, PAUL O., JR., Charleston, W. Va.
HAMMING, KENNETH W., Wilmette, Ill.
HANCOCK, RICHARD N., Basking Ridge, N. J.
HELMIG, GERALD R., Dayton, Ohio
HOLLOWAY, WILLIAM D., JR., Bellaire, Texas
HSU, MICHAEL T., Rugby, England
JENSEN, HARRY M., Chicago, Ill.
JOHNSON, HOWARD W., Bethlehem, Pa.
JOHNSON, MORRIS V., Louisville, Ky.
JURGENSEN, CHARLES A., Trenton, N. J.
KAMPER, WILLIAM H., Murray Hill, N. J.
KARAKAYA, HUSEYIN, Brooklyn, N. Y.
KEENE, CLAIR L., Milton, Mass.
KIMBALL, ALVION L., Boston, Mass.
KOHSIEK, DONALD J., Akron, Ohio
KOSCT, STEPHEN L., JR., Barberton, Ohio
KOSTNER, WALTER R., Chicago, Ill.
KRICKMIRE, JAMES B., Rochester, N. Y.
KROHN, EDMOND A., Dragerton, Utah
LATHAM, JOHN C., Larchmont, N. Y.
LEHNER, JOHN B., Mineola, N. Y.
LEUNG, PUI L., Pasadena, Calif.
LINDSAY, HOWARD H., Houston, Texas
LOEB, ROBERT W., Dayton, Ohio
LUECKEL, WILLIAM J., JR., Manchester, Conn.
LUSAITIS, MAYNARD V., Plains, Pa.
MAEDER, PAUL F., Providence, R. I.
MAGINNIS, JAMES J., Wilmington, Del.
MANNHERZ, ELMER D., Philadelphia, Pa.
MATTHEWS, FRANCIS T., West Hartford, Conn.
MAYNZ, THEODORE, Philadelphia, Pa.
MAYS, WILLIAM A., Amarillo, Texas
MCCORMICK, RICHARD F., Tulsa, Okla.
MCDONALD, CHARLES A., Fort Erie, Ont., Can.
MCINTYRE, BERNARD L., Shawinigan Falls, P. Q., Can.
MENDLER, ROBERT F., Watertown, N. Y.
MERRILL, DOT, Chicago, Ill.
MEYER, CHARLES E., Philadelphia, Pa.
MOLAISON, HENRI J., New Orleans, La.
NELSON, PAUL T., Hollywood, Calif.
NICOL, WILBUR C., Pittsburgh, Pa.
NICOLIN, CURT R., Finspang, Sweden
PASELL, JOSEPH H., North Dartmouth, Mass.
PETERSON, FRANK T., New York, N. Y.
PETRILLO, ALBERT P., Rochester, N. Y.
REESE, RUSSEL D., Portland, Ore.
REITER, SYDNEY H., Philadelphia, Pa.
RICHARDSON, ALFRED, Cheshunt, Herts, England
RICHMOND, HAROLD P., Durham, N. C.
RIMROTT, FREDERICK P. J., Toronto, Ont., Can.
RISING, JAMES S., Ames, Iowa
ROMANELLI, MARCELLO J., Laurelton, N. Y.
ROMZICK, LEO J., Detroit, Mich.
ROSENSTEIN, ALBERT L., Philadelphia, Pa.
ROSS, W. MURRAY, Wilmington, Del.
RUMSEY, JOHN D., Detroit, Mich.
RUTTINGER, HENRY A., Kenmore, N. Y.
RYAN, HAROLD S., Syracuse, N. Y.
RYAN, JOHN M., Baltimore, Md.
SCHARNHORST, FREDERICK R., Kansas City, Mo.
SCHMIDT, KENNETH R., Wichita, Kan.
SCHRANK, JOSEPH M., Waukegan, Ill.
SHAW, JAMES H., Rochester, N. Y.
SHORTRIDGE, WILLIAM F., Stockton, Calif.
SLUHAN, CYLDE A., Toledo, Ohio
SMITH, FRANCIS, W., Salem, Ore.
SMITH, ROBERT K., La Crosse, Wis.
SOUSA, LIONEL A., New Bedford, Mass.
STAHLER, CARL R., Davenport, Iowa
STEWART, WARREN A., Easton, Pa.
SURI, TARLOCHAN S., Howbag, Jabalpur, India
TAIT, WATSON F., JR., Summit, N. J.
THOMAS, HOWARD J., Huntington, W. Va.
THOMAS, WILLIAM W., College Park, Md.
TIBBITS, CHARLES B., Berlin, N. H.
TODD, JOHN, Westfield, N. J.
TOMENCHAK, ARTHUR A., Bridgeport, Conn.
UNGAR, ALBERT B., Staten Island, N. Y.
VAN METER, WILLIAM J., Santa Fe, N. Mex.
WALDEN, KENNETH E., Kansas City, Kan.
WEBER, WILLIAM G., Denver, Colo.
WEIDNER, CHESTER W., Merchantville, N. J.
WEIMANN, FRITZ K. H., Lorain, Ohio
WEIMER, ROBERT D., New Castle, Del.
WEISS, ALFRED B., Detroit, Mich.
WHITE, STANLEY E., Towson, Md.
WILEY, GEORGE F., Denver, Colo.
WILLIAMS, RAYMOND M., Miami, Fla.
WOLANSKY, JOHN, Euclid, Ohio
WOODLING, JAMES C., Akron, Ohio
WOODWORTH, JAMES M., Des Moines, Iowa
WRASE, WILLIAM A., Muskegon, Mich.
ZINK, JOHN S., Tulsa, Okla.

CHANGE IN GRADING

Transfers to Member and Associate

BECKER, RICHARD F., New York, N. Y.
BELZ, PAUL D., Glen Burnie, Md.
BRANCATO, LEO J., Danbury, Conn.
CARR, JOHN D., Youngstown, Ohio
DARLING, DOUGLAS G., Toronto, Ont., Can.
DE POULD, FRANK, Jefferson, Iowa
DOWNS, JAMES B. T., Morgantown, W. Va.
DYKE, JOHN M., Montreal, P. Q., Can.
GRATCH, SEROE, Philadelphia, Pa.
KAMKE, WILLIAM A., JR., Kokomo, Ind.
KLINE, STEPHEN J., Stanford University, Calif.
LESSEN, MARTIN, Springfield, Pa.
MARTEL, FELIX A., Havana, Cuba
POTTER, J. ROBERT, Needham, Mass.
RECORDS, WILLIAM A., North Bend, Ohio
SAMUEL, ALAN J., San Jose, Calif.
SLOGGY, LOUIS, J. B., Alhambra, Calif.
SMITH, CLIFFORD B., Webster Groves, Mo.
STEWART, WALTER R., Berkeley, Calif.
TYLER, BANJAMIN C., Norfolk, Va.
WASSON, JOHN W., Honolulu, T. H.
ZIMMERMANN, WILLIAM F., JR., Birmingham, Ala.

Transfers from Student Member to Associate 50

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th Street	84 East Randolph Street	100 Farnsworth Ave.	57 Post Street

Men Available[1]

Engineer, 38, married, PE Pa., experienced in new plant layout, manufacturing, and general engineering. Me-36.

Plant or Staff Engineer, 44, BS, M.I.T., experienced head of plant-design department in heavy-process industry. Will consider temporary assignment, consulting work, etc. Capable or organizing and supervising plant construction or expansion. Me-37.

Mechanical Engineer, 34, ME, MS, PE. Experienced in complete charge of in-plant functions of medium-sized company. Steel-tank fabrication; also laminating of building curtain-wall materials. New York metropolitan area. Me-38.

Executive Engineer, 32, BME, MME, 14 years' diversifed experience—rocket engines, automatic machinery, atomic energy, guided missiles, pumps, turbines, machine tools, hydraulic presses, compressors, valves. Contract negotitations, planning, scheduling, bid proposals. Desires supervisory or staff position in research and development with progressive industrial concern. Me-39.

Mechanical Engineer, 33, married, veteran, BME cum laude, BSME, Pi Tau Sigma, Tau Beta Pi; four years machine shop, $2^1/_2$ years plant and safety engineering, $2^1/_2$ years supervising design and development; desires responsible position Philadelphia or Trenton area. Me-40.

Mechanical Engineer, registered, ten years' experience design, erection, operation steam-power plants. Specialist, establishing procedures, initial operation, cost accounting, personnel training, rehabilitation programs. Desires permanent position chief engineer, mechanical superintendent. Me-41-767-Chicago.

[1] **All men listed hold some form of ASME membership.**

Mechanical Engineer, 44, married, 20 years' diversified mechanical experience in design, construction, installation, operation, and maintenance of power plants and pressure-vessel projects. Responsible charge multiplant private industrial and governmental projects. BSME, Tufts. Available now. Prefers West, Hawaiian Islands, South America. Me-42-415-D-1. San Francisco.

Mechanical Engineer, 31, married, BME, MS, ScD, Sigma Xi, registered professionally. Ten years' diversified experience in industry and teaching. Desires position with consulting firm or administrative technical work. Me-43.

Director of Development, mechanical, structural, or allied fields, 20 years' diversified experience transportation and aircraft. Excellent record and references. Prefers small or medium-sized organization in East. Will deal only with top executives. Me-44.

Mechanical Engineer, heating, ventilating, and air conditioning; five years' experience. Field experience with contractors, design experience with consulting engineers, also sales experience. Can start work immediately. Will locate anywhere. Me-45.

Industrial-Costs Engineer, BS in ME or ChE; MS in IE, registered PE, 12 years cost analysis of equipment, processes and products, chemical, metal, and heavy mechanical manufacturing, technical reports, materials handling, marketing, development. New York City area. Me-46.

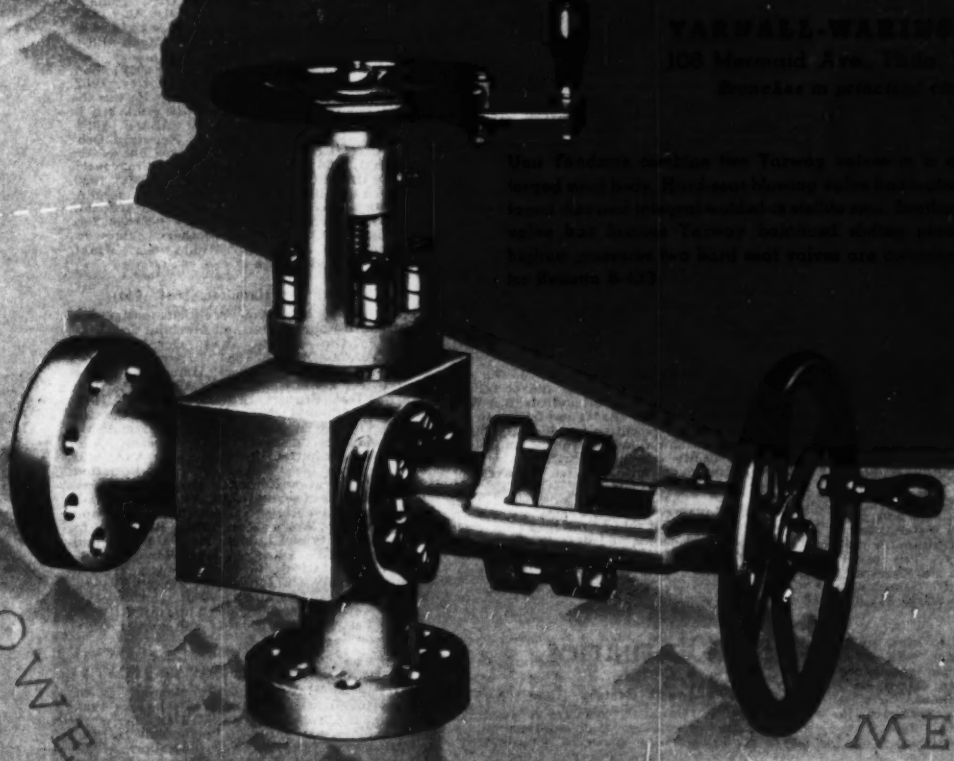
Positions Available

Product-Design Supervisor, mechanical preferred, 15 years' experience in design and development of automatic machinery. Will direct the activities of 12 to 20 designers and draftsmen on projects involving variety of industrial machines and equipment. Bakery equipment is

(*ASME News continued on page 132*)

ALSO IN ARIZONA, IT'S YARWAY

YARWAY UNIT TANDEMS



YARWAY SERVICE GOES ALL THE WAY....

one of many fields of interest. $8000–$8500. East. Y-9358-D-8891.

Plant Engineers, 28–40, BS in ME or equivalent, three or four years' experience, preferably in plant engineering with medium-to-large industrial organization. Should have some experience in supervision, with potential for development to positions in plant management. Position will involve full supervision over the maintenance department in plant planning, scheduling, and supervising various maintenance and construction projects, establishing equipment-inspection schedules for preventive maintenance, and making recommendations for improvements to process machinery and equipment. $7000–$10,000. N. J. Y-9362.

Plant Superintendent, mechanical engineer, thoroughly versed in supervisory work, for a machine-tool shop employing about 90 people. Prefer applicant with several years' experience in an executive position such as plant superintendent or assistant. Company builds new machine tools to the customers' specifications; also repairs machine tools. Salary open. Upstate N. Y. Y-9380.

General Manager, 35–45, mechanical graduate, to take complete charge of a factory employing 100–150 people. Must have experience in cutting tools, particularly taps and dies. Background in labor relations and business management. $12,000–$15,000. Mass. Y-9394.

Operating Vice-President or President for a precision electromechanical manufacturing business selling products to retail consumers, engineered application, and to the government. Should have ability to organize an engineering or product-development department; know how a commercial manufacturing organization should be run; organize and direct a sales department, etc. $15,000–$30,000, depending on qualifications, plus per cent of profits. Long Island, N.Y. Y-9396.

Engineers. (*a*) Instrumentation and control engineer, 26–31, BSME or EE, with diesel, steam, and nuclear power-plant instrumentation and control—pneumatic, mechanical, hydraulic, and working in co-operation with electrical control engineers. Experience ten years in power-plant or process-industry control field. $8000–$12,000. (*b*) Nuclear reactor-control plant engineer, BSME or ChE, with experience in water-cooled reactor-plant systems and associated components including primary coolant, steam generating, evaluation, and air and other systems. Ten years' experience in power-plant or process industry with some background in nuclear power desired. $8000–$12,000. Conn. Y-9405.

Engineers. (*a*) Nuclear power-steam plant engineer, 31, BSME, ten years' experience in steam-power field, preferably marine. Nuclear power-steam plant systems, including steam-feed condensate, circulating water, lubricating oil, gland-seal exhaust, drains, and associated components as turbines, condensers, ejectors, pumps, etc. $8000–$12,000. (*b*) Mechanical engineer, BS, about 29, eight to ten years' experience in heat-exchanger design and fabrication field. Heat transfer, constructional detail, material and fabrication-process design for highly specialized heat-exchange equipment. Should be thoroughly grounded in heat-transfer fundamentals with strong background of construction techniques. $8000–$12,000. Conn. Y-9406.

Engineers. (*a*) Engineer, BSME, eight to ten years' experience, to design investigation and study for specialized pump application in primary coolant service. Pump-design background not necessary, but must be a good mechanical-design engineer thoroughly grounded in heat transfer, material application, bearing design. $8000–$12,000. (*b*) Materials and processes engineer, BSME or ChE, to cover fields of nuclear-reactor plant primary-coolant technology, material application, corrosion, cleaning methods and procedures, welding, and other special material techniques. Should have strong background in material application and chemistry. Ten years' experience in material application and chemistry in process industry or chemical fields. Some background in nuclear reactors. $8000–$12,000 Conn. Y-9407.

Designer, 26–30, BSME, five to nine years' experience as mechanical designer with some valve-design experience, to design specialized valves for primary-coolant systems, steam, feed, condensate, lubricant oil, etc. Should be good mechanical designer, thoroughly grounded in heat transfer, materials, strength, fluid flow, some knowledge of control methods. Conn. Y-9408(*a*).

Engineers. (*a*) General superintendent, 35–45, mechanical graduate, at least 12 years' automotive-production experience, to take general charge of body construction, painting, trim, and assembly on conveyer line. Salary open. (*b*) Production superintendent, 30–40, mechanical graduate, at least eight years' automotive-assembly experience, to supervise frame and body assembly, engine installation, etc. $6180–$9000. (*c*) Assistant plant engineer, 30–45, mechanical, electrical, or industrial-engineering graduate, at least eight years' maintenance and construction experience covering general building maintenance, heating, electrical refrigeration, paint spray, and conveying equipment. $6180–$9600. East. Y-9413.

Designer-Draftsmen and Engineers, practical experience in process-equipment design, research and development, plant layout, method improvement, or general engineering for southern board manufacturer. Salary open. Y-9422.

Plant Superintendent for a small spring manufacturer employing at present about 75 persons. Should be 35–55, five to ten years' experience in the spring business who has acted as superintendent in a small plant, or as assistant superintendent in a larger spring-manufacturing plant. Company produces smaller-type springs, such as are used in watches and clocks. $12,000–$15,000. Conn. Y-9433.

Mechanical Engineers for consulting engineering firm. Should be young, minimum of five years' experience in design of public-utility power stations. Pa. Y-9451.

Industrial Engineer, 35–50, mechanical graduate, five to ten years' experience in material handling, warehousing, receiving, and shipping. Will handle department of 300–400 people. $8000–$10,000. Ga. Y-9461.

Project Engineer, mechanical graduate, to design and prepare for fabrication, mechanical parts for potentiometers. $6600–$7200. New York, N. Y. Y-9465.

Engineering Educator, 28–40, for nationally-known manufacturer of engineering materials for general sales-management staff. Must have well-rounded engineering background and extensive experience as engineering educator. Duties will be to assist sales manager in evaluation and development of engineering supply products for educational market and to originate merchandising techniques used by salesmen in selling to college bookstores, high schools, etc. Some traveling for educational meetings and key-customer contact. Salary open. Headquarters, Chicago, Ill. Y-9468-C-1463.

Project Engineer, mechanical or electrical, up to 45, at least two years' experience in design or development of controls with inventive and creative flair. Knowledge of electrical circuitry and make-and-break switches. Will design and develop new controls and gas-control equipment for a manufacturer. $6000–$10,000. Employer will pay fee. Ind. C-1443.

Chief Manufacturing Engineer, 35–45, at least five years' experience in nonferrous foundry practice, machine-shop operations, welding and assembly work, and close tolerances. Knowledge of fast production and low costs. Will compute charge of manufacturing-engineering department covering manufacture and assembly of small, precise mechanical and electromechanical parts on a mass-production basis including tooling, die-making, and general plant maintenance for a manufacturer of valves. $14,000–$18,000. Ohio. C-1456(*b*).

Sales and Operations Engineer, 35–50, at least ten years' experience in sales and/or utility work. Knowledge of Midwest industries. Will develop and look for new clients and follow up on them as an account executive on all phases such as design, construction, and consulting on utility work for a utility consulting engineer. Up to $15,000. Employer will pay fee. Travel 50 per cent—home week ends. Ill. C-1473.

General Manager, 40–55, ten years' experience in executive capacity for operating an oil pipe line. General manager and top operating engineer for oil pipe line. $15,000. Travel 30 per cent of time. Employer will pay fee. Wyo. C-1475.

Obituaries

Luther Wadsworth Bridges (1868–1952?)

LUTHER W. BRIDGES, mechanical engineer, specialist in the design and construction of power plants and gas works, of Framingham, Mass., died according to notices received by the Society. Born, Hopkinton, Mass., Jan. 10, 1868. Education, BS, Massachusetts Institute of Technology, 1889. Mem. ASME, 1915.

Myron Henry Clark (1881–1953)

MYRON H. CLARK, proprietor, Myron Clark Associates, Boston, Mass., died Aug. 30, 1953. Born, Bedford, Mass., July 25, 1881. Parents, Charles H. and Abbie (Davis) Clark. Education, BS, Massachusetts Institute of Technology, 1903. Married Augusta Farnum, 1909. Mem. ASME, 1913. He was a past-president of SAM; organizer and first director, Labor-Management Institute, University of Connecticut. During World War II he was regional management consultant, War Production Board, in New England. Author of many papers on management published in various technical publications. Survived by wife; two sons, E. Whittredge, Bedford, Mass., Phillip F., Norwich, Conn; and five grandchildren.

Albert Crossman (1860–1953)

ALBERT CROSSMAN, retired engineer of York, Pa., died according to notices received by the Society. Born, Basel, Switzerland, Oct. 17, 1860. Education, ME, Polytechnic Institute, Zurich, Switzerland, 1881. Naturalized U. S. citizen, Brooklyn, N. Y., 1893. Mem. ASME, 1903.

Thomas Joseph Cullen (1901–1953)

THOMAS J. CULLEN, Arkansas sales representative, Ruberoid Co., Little Rock, Ark., died Oct. 3, 1953. Born, New York, N. Y., Sept. 18, 1901. Education, BS(ME), New York University, 1924. Jun. ASME, 1925. Survived by wife, Mabel, a brother, and two sisters.

Oswald Hewitt Dodkin (1902–1953)

OSWALD H. DODKIN, chief hydraulic engineer and head of planning section, São Paulo Tramway, Light & Power Co., Ltd., died Sept. 7, 1953, in São Paulo, Brazil. Born, Foxborough, Mass., June 22, 1902. Parents, Alfred T. and Faith Dodkin. Education, BS, Worcester Polytechnic Institute, 1923. Married Florence Dawson, 1930. He was the author of technical papers presented before and published by ASME. Mem. ASME, 1947. Survived by wife and two daughters, Ray F. and Roberta F.

Henry Parsons Erwin (1881–1953)

HENRY P. ERWIN, investment banker, secretary, board of trustees, The George Washington University; treasurer, American Ordnance Association, died in Washington, D. C., June 3, 1953. Born, Newark, N. J., July 16, 1881. Parents, Richard O. and Mary E. (Parsons) Erwin. Education, BA, University of Michigan, 1904; graduate, Illinois Institute of Technology; attended University of Chicago, 1916–1917; hon. DS, The George Washington University, 1952. Married Helen Peck Blodgett, 1921. He was the author of articles on water supply published in various trade magazines. Mem. ASME, 1924. He received the Crowell Medal, American Ordnance Association (of which he was one of the founders), 1946; special citation for military merit and the Regular Army World War II medal, 1950. Survived by wife and three children, Mrs. John A. Croghan, Alexandria, Va.; Mrs. Macdonald Goodwin, Kensington, Md.; Henry P. Erwin, 2nd, Washington, D. C.; two brothers, James A., Chicago, Ill., Walter B., Minneapolis, Minn.; and three grandchildren.

Chester Brown Hamilton (1884–1953)

CHESTER B. HAMILTON, president and general manager, Hamilton Gear and Machine Co., Ltd., Toronto, Ont., Can., died Oct. 5, 1953. Born, Toronto, April 8, 1884. Parents, Chester B. and Anna (Van Wagner), Hamilton. Education, BASc, Toronto University, 1907; ME, 1920. Married Doris Stupart, 1923. Jun. ASME, 1909; Mem. ASME, 1914; he was instrumental in forming the Ontario Section. He also served on ASME subcommittees on Standards for Gears; Joint Sectional Committee on gears (under ASA) with the American Gear Manufacturers' Association; and on Lubrication Committee of ASA. He was also a member of several other American, British, and Canadian professional societies. His paper on "Tests of Worm-Gear Speed Reducers for Power Capacity and Lubrication Data" was published in 1933. During World War II he developed a substitute bronze for worm gears to conserve scarce tin and offered all industry the free right to utilize the analysis. Survived by wife; two daughters, Elizabeth and Mrs. Ronald L. MacFeeter; a son, David; and a sister, Myra Hamilton.

Harry Parker Hammond (1884–1953)

HARRY P. HAMMOND, dean emeritus of the school of engineering, The Pennsylvania State College, and from 1918 to 1937 a member of the civil-engineering faculty at Polytechnic Institute of Brooklyn, N.Y., died Oct 21, 1953. Born, Asbury Park, N. J., Dec. 21, 1884. Parents, George A. and Sarah J. (Snyder) Hammond. Education,

(*ASME News continued on page 134*)

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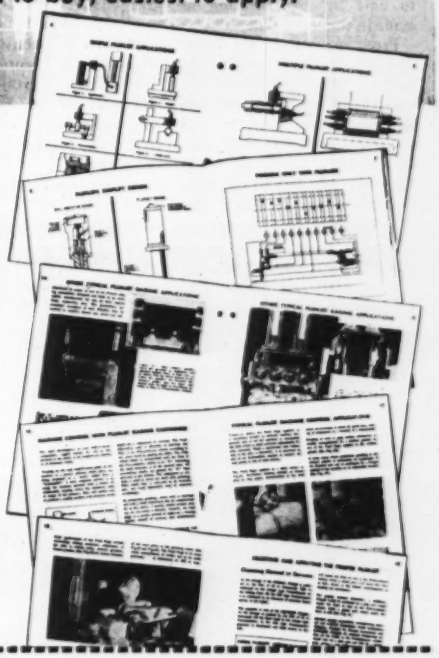

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SHEFFIELD

BS(CE), The University of Pennsylvania, 1909; CE, 1925; hon. DE, Case School of Applied Science, 1931; LLD, University of Vermont, 1943. Married Margaret L. Raymond, 1913. Mem. ASME, 1937. He served the Society on the Special Committee on Education, 1938–1942. He also held membership in many professional and honorary societies. He was chairman, ECPD Committee on Technical Institutes; president, American Society for Engineering Education, 1936–1937; Lamme Medalist, 1945; Hon. Mem., 1952. Recipient of J. H. McGraw Award in technical-institute education, 1950. He was author of many papers on engineering education. During World War II he served as a member of the National Advisory Committee of Engineering Defense Training and was in charge of the inspection of Army Specialized Training program units in the Third Service Command. Survived by wife.

Bernhart H. Hasselbring (1900–1953)

BERNHART H. HASSELBRING, superintendent, maintenance and construction, Mathieson Chemical Corp., Lake Charles, La., died Aug. 31, 1953. Born, Pittsburg, Kan., Dec. 28, 1900. Education, BA(LA), Millikin University, 1922. Mem. ASME, 1946.

Edward Allen Holden (1897–1953)

EDWARD A. HOLDEN, chief engineer, The Engineer Co., New York, N. Y., died March 27, 1953. Born, Brooklyn, N. Y., Jan. 18, 1897. Parents, Richard G. and Rose (Olsner) Holden. Education, attended Pratt Institute; naval school, Stevens Institute. Married Lillian Shaw, 1920. Jun. ASME, 1918; Assoc-Mem. ASME, 1925; Mem. ASME, 1929. Survived by wife; two sons, Edward A., Jr., Richard W.; and three grandchildren.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

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☐ D—Materials Handling	☐ M—Production Engineering	☐ W—Wood Industries
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ Y—Rubber & Plastics
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☐ H—Hydraulics	☐ R—Railroad	

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Theodore Wolsey Johnson (1872–1953)

THEODORE W. JOHNSON, retired, Corps of Professors of Mathematics, USN, rank of captain, died at the Naval Hospital, Annapolis, Md., July 3, 1953. Born, Owego, N. Y., June 4, 1872. Parents, William W. and Susannah (Bacheler) Johnson. Education, attended schools at Boston, Mass., Cambridge, England, and Baltimore, Md.; BA, The Johns Hopkins University, 1892; ME, Stevens Institute, 1896. Married Mary Craven, 1902 (deceased). With five or six other honors, he received the singular honor of being listed as an honorary graduate of the U. S. Naval Academy. He was author of textbooks on mechanical drawing. Survived by a son, Comdr. T. W. Johnson, Jr., USN (ret.), Mem. ASME; a daughter, Mrs. H. V. Larom, Missoula, Mont.; seven grandchildren, and two great-grandsons.

James Madison Labberton (1893–1953)

JAMES M. LABBERTON, professor, marine engineering, New York University college of engineering, and a pioneer in the development of air-conditioning equipment, died Oct. 6, 1953. Born near Hillsboro, N. C., April 22, 1893. Parents, Herman H. and Mary (Efland) Labberton. Education, BS, University of North Carolina, 1913. Married Mary Holton, 1917; daughter, Mary H. Married second, Victoria Dittler, 1938. Mem. ASME, 1937. Author of a textbook "Marine Engineering" and many technical papers and articles on locomotive and marine problems; editor-in-chief, "Marine Engineers Handbook." Held many patents in electrical, mechanical, and refrigeration engineering; designed railway motors widely used by American railroads as well as by the Swiss Federal Railways. Developed Westinghouse Electric and Manufacturing Company's first air-conditioning equipment. While serving as a marine engineer with the Navy, he designed propellors and worked out heat balance for the Navy's first 35,000-ton battleship as well as for destroyers, cruisers, and aircraft carriers. For several years he was curator of NYU's James Arthur Collection of clocks and watches. Survived by wife and a daughter, Mrs. Mary Hartley.

Frank Mossberg (1858–1953)

FRANK MOSSBERG, president of the Mossberg Pressed Steel Corp., inventor, and manufacturer of heavy machinery, died in Attleboro, Mass., Oct. 15, 1953. Born, Blomskog, Sweden, Nov. 8, 1858. Parents, Nils and Sarah (Earson) Mossberg. Education, graduate, Chalmers Technology Institute, Götenborg, Sweden. Naturalized U. S. citizen, Rhode Island, 1886. Married Jennie D. Polsey, 1886. Mem. ASME, 1895. In 1940 he was made an Officer, first class, of the Royal Order of Vasa at a New York World's Fair ceremony by direction of the King of Sweden. He also won the World's Fair Award of Merit and a special Attleboro award on that occasion. He twice served as president of the John Ericsson Society of New York. He held more than 200 U. S. Patents on his inventions including various types of roller bearings, fog signals, and many other mechanical devices; European patents in England, France, Italy, Germany, Sweden, and Belgium. Survived by daughter, Mrs. Florence Vander Pyr.

William M. Kurtz Myers (1883–1953)

WILLIAM M. K. MYERS, chairman of the board of directors of the Penn Steel Castings Co., Chester, Pa., and former president of the old Philadelphia (Pa.) Rapid Transit Co., died Sept. 7, 1953. Born, Millville, N. J., Dec. 17, 1883. Parents, Christian M. and Louisa (Kurtz) Myers. Education, BS(CE), The Pennsylvania State College, 1905. Married Margaret Steinbach, 1909; children, Margaret L., Gordon S. Mem. ASME, 1921.

Rossiter Stockton Scott (1875–1953)

ROSSITER S. SCOTT, mechanical engineer, of Baltimore, Md., died Sept. 1, 1953, according to information received by the Society. Born, Baltimore, Md., Nov. 23, 1875. Education, ME, Stevens Institute of Technology, 1898. Mem. ASME, 1915.

Robert Johnston Weber (1894–1952)

ROBERT J. WEBER, manager, Central Station and Transportation Division, Westinghouse Electric Corp., Pittsburgh, Pa., died Dec. 28, 1952. Born, Buffalo, N. Y., May 3, 1894. Education, BS(EE), Carnegie Institute of Technology, 1920. Married Pearl M. Smith. Mem. ASME, 1944. Survived by wife.

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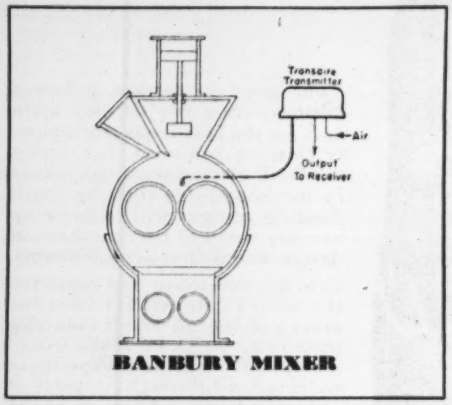


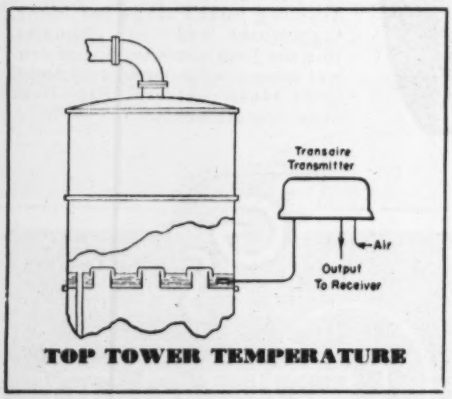
BANBURY MIXER

Compensates for Poor Heat Transfer of Mix

Problem: Poor heat transfer of the rubber compounds in a Banbury Mixer makes it difficult to closely measure the mechanical heat generated. Excessive heat causes deterioration of ingredients—and a very real fire hazard.

Solution: TRANSAIRE Temperature Transmitter, with derivative action (SPEED-ACT) in the measuring system, compensates for both the poor heat conductivity of the mix and the inherent thermal lag of the rugged separable well required. The cigarette-size bulb permits its ideal location, and aids the speed of response, as of course does the THERMOSPEED sleeve in the separable well.

Results: An accurate record of the true *dynamic temperatures* of the mix and the *time* of every batch. Another dividend: the process can now be put under automatic control — never before feasible.



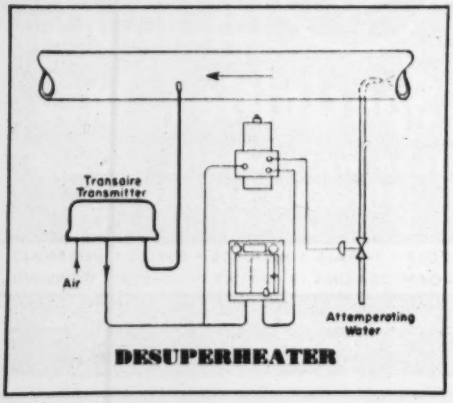
TOP TOWER TEMPERATURE

Short Range Span Detects Temperature Trends

Problem: To get highest possible purity of product consistent with good production economy. This requires the quick detection of temperature trends over a very narrow range.

Solution: The short, shiftable range spans (as short as 50°F.) for the TRANSAIRE Temperature Transmitter permit selection of operating range by a simple screwdriver adjustment. SPEED-ACT feature assures detection of temperature change of less than 1/10 of 1% of span and is accurate to ½% of span.

Results: Close control because the minute temperature trends are practically instantaneously detected and transmitted to the controller and receiver. This means higher yield of a purer product, also great flexibility in changing to different product requirements.



DESUPERHEATER

Fast Speed of Response Catches Rapid Temperature Changes

Problem: Steam at high temperature, as with any gas temperature measuring problem, has poor heat transfer characteristics, making it difficult to measure dynamic temperatures.

Solution: The low heat capacity of the cigarette-size bulb (made possible by the force-balance system), and SPEED-ACT compensation for the rugged well required, give unprecedented speed of response to temperature changes under these adverse conditions.

Results: Smooth efficient operation, and greater protection to expensive equipment in subsequent processing steps.

*Reg. U.S. Pat. Off.

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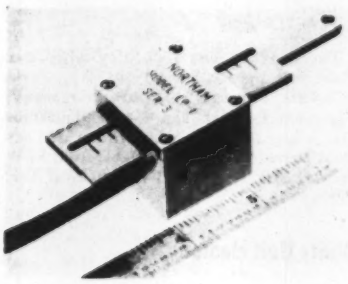
Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING

NEW EQUIPMENT

Pneumatic Instrument Calibrator

A pneumatic calibrator for testing and calibrating pressure instruments which operate between 20 in. H_2O and 25 psi has been developed by Republic Flow Meters Co., Chicago. Performing the same function as an air loader, the calibrator may be adjusted to produce a pre-determined pressure by adding or removing calibrated weights from a weighbeam. Setting output pressures with a manometer is claimed not necessary.



The calibrator operates from a 35-psi air source. Facts about it are included in Form 53-3, available free from Republic Flow Meters Co., 2242 Diversey Pkwy., Chicago 47, Ill.

Hammer Drill

The Syntron Co., 498 Lexington Ave., Homer City, Pa., has announced the latest addition to its line of electromagnetic hammer drills, the Model 23-RO, with a maximum drilling capacity of $1^1/_2$-in. diameter holes. Operation is from 110-v, 60-cycle alternating current. Hammer drills using 220 v can be supplied to order.

The new hammer drill combines the standard electromagnetic hammers with automatic rotation of a spiral-fluted, carbide-tipped drill bit. This automatic rotation is accomplished by a rubber ratchet mechanism which utilizes the recoil of each blow of the hammer piston to turn the bit slightly.

The spiral-fluted, carbide-tipped drills are available from Syntron in a variety of hole diameters. Illustrated literature is available on request.

Air Conditioner

Niagara Blower Co. has announced improved apparatus for treating air with an absorbent spray to fix relative humidity in air conditioning or air drying. In the new model, Series 5700, the air conditioner and the adsorbent re-concentrator are combined in one machine.

The equipment is manufactured by the Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y. The model is manufactured in a range of sizes from 1000 to 5300 cu ft of air per min. Equal capacity is provided in less than half the space required by previous models, according to the manufacturer.

Aircraft Switch Housing

Mycalex Corp. of America, Clifton, N. J., has announced production of a custom-molded switch housing for airborne applications. The new switch housing is molded of Mycalex 410X glass-bonded mica.

The Mycalex switch case is said to far exceed normal requirements for ability to withstand repeated arcing. In addition to immunity to repeated flashing, the company says, no carbon path is formed in tests using Mycalex 410X. Closely dimensioned intricate functional designs, high dielectric strength, zero moisture absorption, and permanent dimensional stability at temperatures up to 650 F are claimed for Mycalex glass-bonded mica.

For complete engineering data on Mycalex glass-bonded mica for switch housings, connectors, and other electrical components, readers are invited to write to Mycalex Corp. of America, 60 Clifton Blvd., Clifton, N. J.

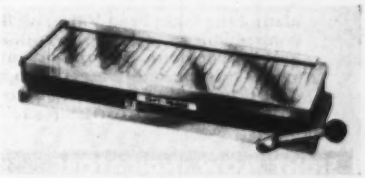
Union Bonnet Gate Valves

Full production of a new line of 125- and 150-lb union bonnet bronze gate valves has been announced by The Ohio Injector Co., Wadsworth, Ohio. The new valves have these features, according to the company: heavy, lug-type hexagonal union rings; a flexible T-type stem to wedge connection with bronze wedges; thread chambers proportioned to prevent the ends of the connecting pipe from contacting the seat walls; full-size ports to keep turbulence and pressure drop to a minimum; and a back-seating arrangement, to permit repacking under pressure.

The new 125- and 150-lb union bonnet gate valves now available are equipped with the new OIC 40 alloy valve stem material. Further information is available on request.

Permanent Magnet Chucks

The Taft-Peirce Superpower Permanent Magnet Chuck has been added to this company's line of magnetic chucks. Of a new design, these chucks are said to be compact and 15 to 20 per cent lower in height than other makes.



Taft-Peirce Superpower Permanent Magnet Chucks under normal conditions will retain their peak energy indefinitely, it is claimed. Holding power is controlled by progressive positioning of the hand lever, from minimum to maximum. Because no electrical current is applied, the chuck operates without heat.

Taft-Peirce Superpower Permanent Magnet Chucks are recommended for surface grinding, light milling, planing, and shaping.

Buna N Compound for — 40 to 325 F

The Goshen Rubber Co. has introduced Compound 1225, a new development of Buna N, claiming outstanding properties of heat resistance (300–325 F), good oil-resistance properties, and very low compression set at elevated temperatures. It is also flexible as low as −40 F, according to the company. Other high physical properties include tensile strength of 2500 psi, elongation of 350 per cent, and durometer of 70 points.

Further information is available from the Goshen Rubber Co., Inc., Goshen, Ind.

Air-Driven Hydraulic Pump

The Aldrich Pump Co., Allentown, Pa., has announced production of an air-driven hydraulic pump. The unit is available in single- or double-acting models, is a simplex horizontal type, and has small-volume capacity at medium and high pressures.

The pump develops up to 20,000 psi operating on 90-psi air supply and is a self-contained machine complete with air filter, regulator, lubricator, and hydraulic pressure gage. Aldrich recommends this pump for such applications as the testing of tubing, valves, and pressure vessels, and the supplying of power for small molding presses.

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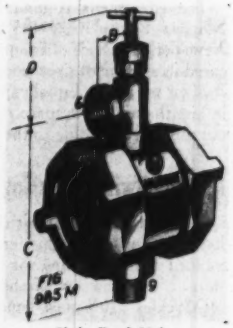
SIGHT FEED VALVES

Sight Feed Valves provide a means of regulating and visually checking oil flow at the point of delivery to bearings, gears, etc. By regulating the Sight Feed Valve, oil flow is controllable from 2 drops per minute up to 21 U.S. gallons per hour. The oil stream through the valve is visible at all times through a removable, dust-proof sight glass. Sizes ¼" to ¾" i.p.s. for working pressures to 125 p.s.i.



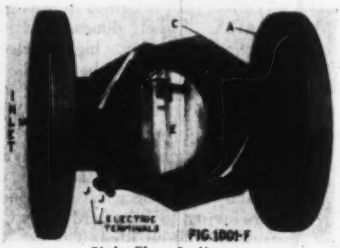
Sight Feed Valve

SIGHT FLOW INDICATORS

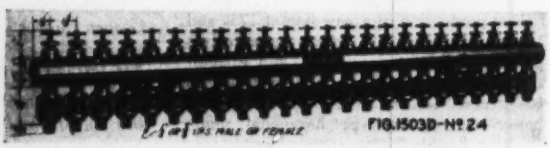
With a Nugent Sight Flow Indicator installed in your lubrication system, you can tell at a glance whether or not oil is flowing properly to vital parts. The Sight Flow Indicator can also be wired with an alarm bell to sound in any desired location —enables you to correct troubles quickly and protect valuable equipment. Windows are removable for cleaning. Sizes from ½" to 6".

MULTIPLE OILERS

Nugent Multiple Oilers are designed for lubricating enclosed bearings and other hard-to-get-at spots. Oil from a pump or reservoir is piped to the oiler and fed to the bearings by means of tubing through independently adjustable needle valves. Available in a variety of types with any number of feeds.
In addition to lubrication specialties, Nugent offers a complete line of lubrication devices and oil filters. Write for descriptive literature, mentioning the type of equipment you are interested in.



Sight Flow Indicator



Multiple Oiler

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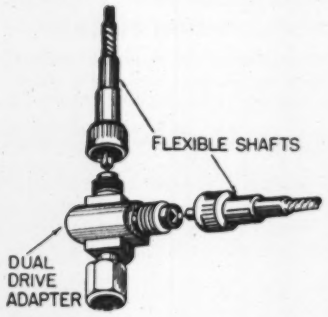
KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Dual Drive Adapter

The F. W. Stewart Mfg. Corp. has announced a "Circle Ess" Dual Drive Adapter recommended for use in conjunction with flexible-shaft drives where more than one unit is to be driven from the same power source; to provide two ratios from the same source or to facilitate attaching flexible shaft drives where limitations in space prevent direct connection without bending the shaft to the point of possible damage. It is furnished with standard ⅜ in. × 18 threaded connections with 0.104 in. internal square drives and in ratios of 1 to 1, 15 to 1, 16 to 1, and 17 to 1 for either left or right rotation.



The body is aluminum alloy with brass connectors and the hardened-steel gears run in oil-lite bearings which are permanently lubricated for high and low temperatures. The weight is 4 oz. A bulletin on this new Dual Drive Adapter is available from F. W. Stewart Mfg. Corp., 4311 Ravenswood Ave., Chicago 13, Ill.

Utility Unit Heater

L. J. Wing Mfg. Co., Linden, N. J., manufacturer of heating, ventilating, and combustion equipment, has announced a new type of construction on certain sizes of the Wing Utility Unit Heater, a horizontal-discharge heater, as well as on the suspended, vertical-discharge Wing Revolving Unit Heater. The feature of this construction lies in combining the motor mount with an integral safety guard. The result, it is claimed, is a more rigid type of motor mounting and more strength in the safety guard. Bulletin is available.

Cast Steel Steam Trap

Armstrong Machine Works, Three Rivers, Mich., has announced the No. 983, a cast steel side-inlet side-outlet trap with integral strainer. The mechanism is corrosion-resistant stainless steel, identical in design and construction to the mechanism used in traps for 900-f, 950-psig duty, according to Armstrong.

Pressure range is from 0 to 600 psig, maximum capacity is 4400 lb/hr. Connections are ½ in., ¾ in., or 1 in. screwed, flanged, or socket weld. Additional information is available from the company.

Valve for 1500-psi Oil Service

The patented Shear-Seal principle has now been made available in a 1500 psi series of manual valves for oil service, Barksdale Valves has announced. Leak-proof closure, high flow capacity, low handle load, no freeze-ups, excellent throttling, no wire-drawing, and not critical to dirt are among the advantages claimed.

Valves range from 1/4 to 1 inch pipe size. Catalog and design data are available from Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Cal.

Miniature Gear Motors

Mission-Western Engineers, Inc., Pasadena Cal., affiliate of Western Gear Works, has announced a series of permanent magnet d-c motors and gear motors. These miniature motors can be supplied with overload torque limiting clutches. Shown in the photograph, they measure $1^{3}/_{16}$ in. in diameter and 4 in. in length. Because these are gear motors the output speeds can be varied by changing the gear set to as little as 1 rpm, the manufacturer says. The motors are designed to conform with military specifications.

Inquiries should be addressed to Mr. Fred J. Andrew, Mission-Western Engineers, Inc., 132 W. Colorado Blvd., Pasadena 1, Cal.

Impact Drilling Tools

Ingersoll-Rand Co. has announced a Size 2U electric Impactool designed for nut running, tapping, screw driving, reaming, drilling, and other jobs. Rated for nut running up to 1/4-in. bolt size, the 2U Impactool automatically delivers a series of rotary blows to the work when resistance to turning is met, without kick or twist to the operator.

The 2U Impactool is recommended for use in electric motor and small gasoline engine repair, sheet metal work, equipment installation and repair, and a multitude of general maintenance applications where a small, powerful tool is needed for nut running, reaming, tapping, etc.

Tool weighs 5 lb, and measures $9^{3}/_{8}$ in. overall, with side to center distance $1^{15}/_{32}$ in. Motor cannot be burned out by over loading, and will operate from any 110-v source, 60, 50, 40, and 25 a-c cycles, or direct current.

The Size 2U electric Impactool is offered through Ingersoll-Rand distributors as a bare tool, or in various general service kits. The 2U Impactool is the latest in Ingersoll-Rand's line of electric Impactools, with larger sizes available for work to 3/8-in., 5/8-in., and 1 1/4-in. bolt size. Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Miniature Ball Bearings

Landis & Gyr, Inc., 45 West 45th St., New York 36, N. Y., has announced that RMB Miniature Ball Bearings are now made in the R-2 size, with OD 0.3750 in., bore 0.1250 in. and width 0.1562 in., in two basic constructions and 10 different types.

Five of the new R-2 size bearings feature the RMB capillary type Filmoseal closure, and are identified as the RF 864 series. This Filmoseal closure uses a capillary principle permitting the use of oil as a lubricant, rather than grease. The R 864 series includes R-2 size bearings without seals. Both the R 864 and the RF 864 series are available in ABEC 1, 3, and 5 tolerances. RMB R-2 size bearings are available for shipment, with experimental quantities available from stock. A Data Sheet R2-29 is available giving details and specifications.

Sectionalized-Cylinder Compressors

Pennsylvania Class ATH air and gas compressors now employ sectionalized cylinders arranged in three pieces, with the inlet and discharge valves in the fronthead and backhead, according to a company announcement. All are equipped with cylinder-liners as standard.

Several advantages are claimed as a result: first, because the cylinder is sectionalized, the liner may be speedily removed without disconnecting inlet or discharge air piping; second, valves in the heads with this new sectionalized-cylinder construction allow better cooling.

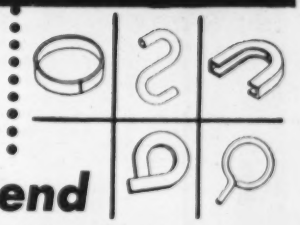
Class 3-ATH compressors are available in single-stage 100-psig discharge-pressure sizes at this time, the company states. Further details are available from the Pennsylvania Pump & Compressor Co., Easton, Pa.

Steam-Turbine-Driven Centrifugal Pump

The Type DE Coffin Turbo Pump is a single-stage, high-speed, steam-turbine-driven centrifugal pump, furnished with a pressure regulator and speed-limiting governor at no extra cost. The unit is designed for compact external piping. Pump and turbine rotor are mounted on a common alloy-steel shaft.

The pump utilizes both a speed-limiting governor and a pressure regulator operating through an oil relay. The unit has varied industrial uses, according to the manufacturer, particularly in the oil and chemical fields, for boiler feed and other services. The turbo pump covers a volumetric range to 800 gpm, discharge pressures to 1000 psig, steam temperatures to 850 F, exhaust pressures to 80 psig, and liquid temperatures to 325 F. For special installations these ratings can be exceeded, Coffin states.

Further details on the new Type DE Coffin Turbo Pump, and others in the Coffin line of Turbo Pumps, will be supplied by the J. S. Coffin, Jr., Co., 326 South Dean St., Englewood, N. J.



Bend a Variety of Materials

Accurately, Easily, Quickly with a DI-ACRO* BENDER

Simple and complex bends can be formed and duplicated in many ductile materials with a versatile Di-Acro Bender. Bending capacity of the five hand operated models ranges from 1/16" wire to 1" round mild steel bar. Many accessories are available for bending various materials and shapes. The Di-Acro Bender can be delivered completely tooled for most forming requirements in solid materials and tubing.

*Pronounced Die-ack-ro

DI-ACRO HYDRA-POWER BENDER

A universal hydraulically operated bending machine that is equally as flexible as hand operated machine. Di-Acro Hydra-Power Benders are especially designed for those long runs and heavy bending operations which are impractical for manually operated equipment.

Creators of "DIE-LESS DUPLICATING"

WANT MORE INFORMATION?
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Gives complete details on hand and power operated Di-Acro Benders, Brakes, Notchers, Punch Presses, Rod Parters, Rollers and Shears. Send for your copy today—there's no obligation.

O'NEIL-IRWIN MFG. CO.
308 8th Avenue
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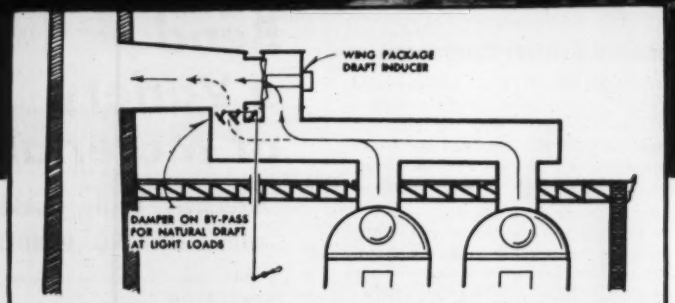
di-acro PRECISION METALWORKING MACHINES

The WING Package DRAFT INDUCER



WING PACKAGE POWER PLANT DRAFT INDUCER at WELCH GRAPE JUICE COMPANY'S PLANT AT WESTFIELD, N.Y. SERVES TWO 20,000 lb./hr. BOILERS. NOTE (A) INDIVIDUAL CONNECTION FROM EACH BOILER (B) BY-PASS WITH DAMPER CONTROLLED FROM BOILER ROOM, PERMITTING NATURAL DRAFT AT LOW LOADS (C) RELATIVE LIGHT WEIGHT AND COMPACT PACKAGE DESIGN PERMITS SUPPORT ENTIRELY ON COMMON BREECHING.

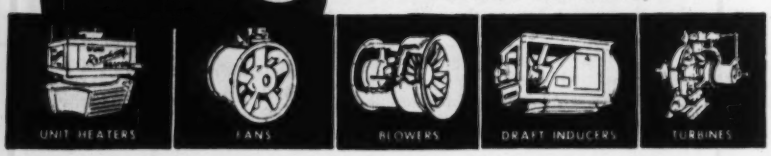
The WING Package DRAFT INDUCER is unique in that the motor (or turbine) and fan is designed as one complete removable unit, making installation easier and being easily removed, facilitates inspection and maintenance. Other advantages are:

1. Big savings in space requirements
2. Permits fewer and lighter structural supports
3. Eliminates field line-up problems
4. Eliminates water cooling
5. Only two support bearings
6. Wide flexibility in gas outlets
7. Saves on investment and maintenance
8. Low load ratings on natural draft because of ample free gas travel area

Write for complete details

L. J. Wing Mfg. Co.
156 Vreeland Mills Road
Linden, New Jersey

Wing



KEEP INFORMED

Plastic Tank Truck

Details on the use of an aircraft-type construction in a milk truck have been released by the tank's manufacturer, Brodix Corp., 57 South Ave., Fanwood, N. J. Monocoque construction, using two Fiberglas shells with two inches of balsa wood between, reduced the weight of the 4000-gal tank trailer at least 2000 lb below that of any conventional all-steel trailer, according to the manufacturer.

A stainless steel lining is used to meet sanitary requirements. The payload advantage is claimed to enable the entire cost of the unit to be paid off in two years. Building of the tank trucks was supervised by the Dairymen's Cooperative League of America, Inc., purchaser of the equipment.

Stainless Steel Float Trap

A float trap made entirely out of stainless steel has been developed by the V. D. Anderson Co. for draining corrosive liquids from air, gas, and steam confined in piping systems and equipment. Chief applications for the float trap are said to be in the chemical, petro-chemical, refining, natural gasoline, textile, paper-making, and food industries, where corrosive liquids are handled.

The trap mechanism consists of a valve and seat, a lever, and a ball float inside of a case, all of stainless steel. The liquid enters the unit at the top, raises the float, opening the valve and permitting the escape of the liquid. An accumulation of any steam or gas lowers the liquid float, causing the float to drop. This action closes the valve.

The trap is designed for 300-psi pressure and maximum total temperature of 800 F. It is made in sizes $\frac{1}{2}$ in. to 2 in. Inquiries should be directed to Dept. S, the V. D. Anderson Co., 1935 West 96th St., Cleveland 2, Ohio.

Intake-Exhaust Silencers

Two new series of silencers for quieting the noise produced by air compressors, blowers, vacuum pumps, and other machines expelling high-velocity air to atmosphere have been developed by Burgess-Manning engineers. To be known as the Series CA and LCA, these silencers are designed for operation under moisture-free air conditions and for temperatures up to 200 F.

Both series are absorption-type silencers employing straight-through, acoustically transparent, perforated tubes surrounded by a deep layer of sound absorbing material. Special sound-absorbing material can be used for operation at considerably higher temperatures than the standard of 200 F, Burgess-Manning says.

The CA Series is available in pipe sizes up to 6 in., and the LCA Series is available in sizes larger than 6 in. Literature is now available on both the Series CA and LCA and may be had by writing directly to Mr. H. A. Dietrich, Burgess-Manning Co., Libertyville, Ill.

KEEP INFORMED

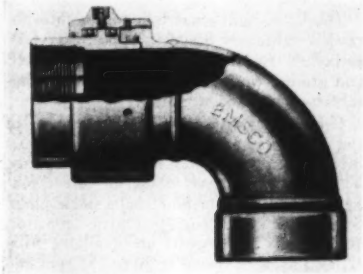
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Permanent-Magnet Alternators

A new Westinghouse a-c generator, with only permanent magnets for field supply, occupies less space than an 8-in. cube yet delivers 1 kw, the company has announced. High magnetic energy per unit volume and high tensile strength are claimed for the two-pole permanent Alnico-alloy magnet, which are said to permit the machine to operate at high speed. Generators of this type are recommended by Westinghouse for small emergency power units where a separate source of direct current for the field would be inconvenient. Further details are available from Westinghouse Electric Corp., Pittsburgh 30, Pa.

Low-Pressure Swivel Joint

The Emsco Mfg. Co. has announced a Ball Bearing Swivel Fitting line designed for applications and pressures to which schedule 40 pipe would be subjected. The Type LPR Emsco Fitting illustrated is designed for a maximum pressure of 1000 psi at a maximum temperature of 225 F. Other types are available for pressures up to 15,000 psi and temperatures to 750 F.



Emsco offers over 500 various types, styles, and pipe sizes ranging from $1^1/_4$ in. to 4 in. End connections may be scarfed, bored for welding, threaded, or flanged to meet customers' specifications. Requests for catalog and prices should be sent to Dept. 21, Emsco Mfg. Co., P.O. Box 2098, Terminal Annex, Los Angeles 54, Cal.

Sectional Boiler-Gage Glass

Diamond Power Specialty Corp., Lancaster, Ohio, uses a sectional gage glass in its higher-pressure gages. Instead of using a long slender piece of glass, with attendant high stresses, Diamond divided the glass into a series of short fitted sections, and mounted with thin mica separators in the joints. The serious strains are said to be absent in these short pieces and gage outages due to glass failure are claimed cut to a fraction.

Diamond now furnishes these sectional glasses on all Bi-Color Gages operating at pressures in excess of 1350 psi. Further information on Diamond Water Gages is contained in Bulletin 1051.

to keep work revolving
at correct speeds
on Reed Turning Rolls

Rotating tanks, cylinders and pipes weighing up to 2000 lbs. for welding, painting or flame cutting, this Turning Roll, manufactured by Reed Engineering Company, is quickly adjustable to handle any diameter from 3″ to 6′ and any length from 12″ to 12′.

Powered by a ½ hp, 3-phase motor, a reversible Winsmith Worm Gear Speed Reducer, in conjunction with a variable speed drive, provides the uniform rotation needed here. Correct turning speeds are assured!

On the basis of ruggedness, compactness and freedom from maintenance, Winsmith Speed Reducers are rated first by first-rating producers of numerous types of equipment.

To fit your speed reduction requirements within the 1/100 to 85 hp range, in ratios of 1.1:1 to 50,000:1, the Winsmith line of fully standardized worm, helical and differential designs is most complete. For details, request Catalog 148.

WINSMITH, INC.
333 June St.
Springville (Erie County), N. Y.

Applications of cathode-ray oscillography

WELDING CURRENT vs. ELECTRODE DISPLACEMENT

Physical Setup: An electrostatic-stored-energy "Weldpower" welding control and associated welding head for resistance welding of non-ferrous materials.

The Problem: To correlate displacement of the welding electrode with the flow of welding current to determine the rate of "follow-up" (forging motion) during welding of copper and other non-ferrous materials.

The Solution: Both welding current and electrode position are plotted against time on a dual-beam cathode-ray oscillograph* operated with both channels on a common time base. The oscillograph sweep is triggered by external equipment which triggers the sweep shortly before the welding action to insure that the presentation will be in the center of the screen.

The welding-current waveform (A) is derived from the voltage drop across a high-current shunt. This voltage is proportional to the welding current and is fed to one channel of the cathode-ray oscillograph. At the same time a timing oscillator feeds 1000 cycle-per-second voltage pips into the z-axis of this channel to provide blanking marks at 0.001 second intervals.

A flag on the welding electrode partially interrupts a light beam as the electrode travels downward. The light beam is focused on a multiplier phototube. For the short electrode travel, the multiplier phototube output is proportional to the position of the electrode at any instant and this output is applied to the second channel of the cathode-ray oscillograph (B). The oscillograph screen was calibrated by static measurements of current and displacement.

In this test, a cross-wire weld was made on #18 hard-drawn, tinned copper wire. The oscillogram, taken with an oscillograph-record camera**, shows that the current (A) with 0.001 second timing marks imposed, rises to the 8000 ampere peak (1) in about 0.002 seconds. Waveform (B) shows that the metal to be welded became plastic at the peak current where the downward travel of the electrode began (2). After 0.004 seconds the metal solidified, electrode motion stopped (3) and the weld was completed. In this time the electrode traveled downward 0.025 inches (3). Variations in (B) following the completion of the weld result from slight mechanical oscillation in the welding head. This identical setup is used to plot the force exerted by the welding electrode during the welding cycle except that the displacement waveform (B) is differentiated twice (d^2s/dt^2) with very simple electrical circuits to derive force.

An application of cathode-ray oscillography by the Raytheon Manufacturing Company, Equipment Engineering Division, Waltham, Massachusetts.

*Du Mont Type 322 **Du Mont Type 297

DU MONT *for Oscillography*

For further information concerning the Du Mont instruments used in this application, contact:

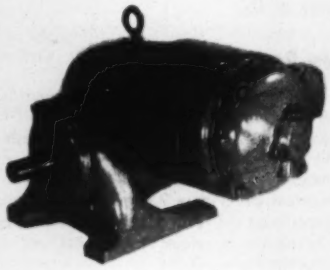
ALLEN B. DU MONT LABORATORIES, INC.

Technical Sales Department • 760 Bloomfield Avenue, Clifton, New Jersey

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Explosion-Proof Gear Motor

For locations where dangerous fumes, inflammable gases, explosive substances, or combustible dusts may exist, U. S. Electrical Motors Inc. has announced its right-angle Syncrogear with explosion-proof motor. Available in 1-hp rating with speeds from 45 to 155 rpm, this three-phase a-c motor is known under the manufacturer's designation as Type SESV-GW. The explosion-proof motor is designed to comply with Underwriter's specifications for Class I—Group D, and Class II—Groups F and G service.



The U. S. right-angle Syncrogear incorporates a cantilever design. Type SESV-GW embodies splash lubrication, a hardened and ground worm, normalized castings, and asbestos-protected windings.

Other right-angle Syncrogear motors of the U. S. line include a combination Varidrive-Syncrogear motor for variable speeds, a footless Syncrogear motor for direct connection to driven machine, and a single-phase Syncrogear motor equipped with capacitor. Right-angle Syncrogears are available from $\frac{1}{4}$ to 3 hp with speeds of 20 to 155 rpm and ratios up to 58:1.

Detailed information concerning these motors can be obtained from U. S. Electrical Motors Inc., Box 2058 Terminal Annex, Los Angeles 54, Cal.

Vibration Detector

A crystal-type accelerometer designed as a basic detection element for use in measuring vibration acceleration up to 50 Gs in large rotating apparatus has been announced by the General Electric Co.'s Special Products Section, Schenectady 5, N. Y.

Called the vibration detector, the GE design meets requirements for use on turbine generators, large motors, blowers, steam and gas turbines, and centrifuges.

The detector was developed by the company's General Engineering Laboratory.

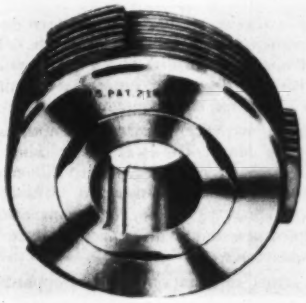
With a frequency response of less than 1 db rise at 1000 cps, the accelerometer's lowest resonance is greater than 2500 cps with a capacitance of 300 $\mu\mu f$. Temperature effect is plus or minus five per cent from −20 deg to +80 C. The GE vibration detector weighs four ounces and is $1^7/_8$ in. high with a $1^1/_{16}$-in. diameter.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Machinery Clutch Unit

The Carlyle Johnson Machine Co., Manchester, Conn., has introduced the Maxitorq Disc-Pac, a self-contained unit independent of the actuator, for use by machine and product designers who wish to build their own clutches or brakes.



Units are available in eight disc diameters from 2 in. to 8 in.; 1/4 to 15 hp at 100 rpm; with three lugs on the smallest size, eight lugs on the 3-hp, and 12 lugs on the 5-, 10-, and 15-hp capacities. The Disc-Pac fits Maxitorq standard Driving Rings. The company states that all assembly, take-apart, and adjustments are manual. Specifications and quotations may be obtained by writing the manufacturer.

Ultrasonic Burglar Alarm

An alarm that uses inaudible sound traps intruders by their motion in a room or similar enclosed area. The system was invented by Mr. Samuel Bagno, vice president of the Alertronic Corp., 48-13 Van Dam St., Long Island City, N. Y., and is manufactured by the company.

Operating on the principle of magnetostrictive vibrations, the supersensitive burglar alarm reports any disturbance of the ultrasonic waves transmitted within an enclosed area.

The sensitivity of the system can be controlled like the volume of a radio. It is usually set to detect a body as small as a child's, but can be tuned to such high sensitivity that a deep breath, a wink of an eye, or wiggling finger will start it, the manufacturer says.

Ultrasonic vibrations are generated from four nickel rods, thin as wooden matches and twice as long, supplied by the International Nickel Co., Inc., New York 5, N. Y.

ONE BANNER
under which all may serve

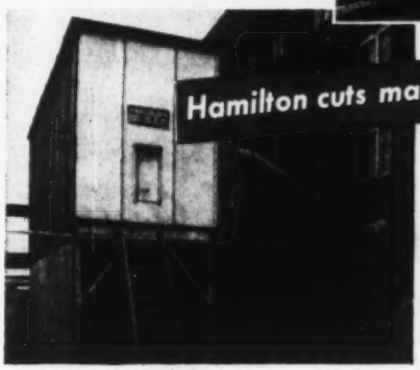
How Can Pangborn Dust Control Save You Money?

Here's how these firms saved with Pangborn:

Nalco salvages $50 a day

National Aluminate Co., Chicago, Ill., **uses seven Pangborn Dust Collectors to trap valuable chemical dusts at the source . . . saves well over $50 a day. Nalco reports that reclamation savings "have already paid for the Pangborn Collectors."**

Hamilton cuts maintenance $100 a month



Hamilton Rubber Co., Trenton, N. J., **installed Pangborn Dust Control to improve employee morale and reduce plant housekeeping. Pangborn did this and more—savings in maintenance, housekeeping, and machine repairs give Hamilton a bonus of $100 a month!**

THE case histories above tell our story. Whether you want to increase profits by reclaiming valuable dust or cutting maintenance costs . . . whether you're interested in improving working conditions or community relations . . . whether your needs are big or small, Pangborn will solve your dust problem. For information on how Pangborn can save you money, mail the coupon below now!

Look to Pangborn for the latest developments in Dust Control and Blast Cleaning equipment

Pangborn DUST CONTROL

STOPS THE DUST HOG from stealing profits

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PANGBORN CORPORATION,
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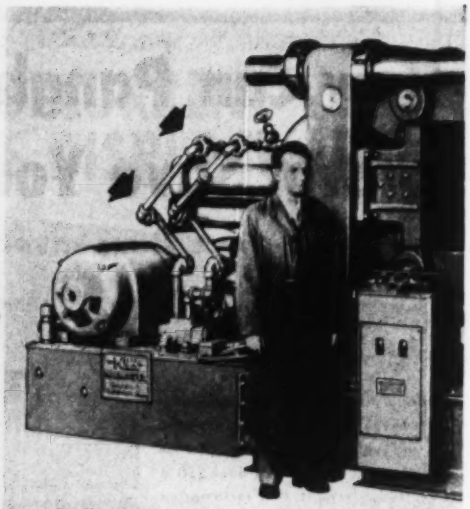

HYDRAULIC APPLICATION

"Dog Leg" piping connections made with Barco Swivel Joints to the hydraulic cylinder of this Kux Die Casting Machine permit quick movement of the press head to any desired position.

BARCO *Swivel Joints*

SAFETY is one significant reason for using Barco Swivel Joints on HYDRAULIC APPLICATIONS. Pressures often run to 3,000 psi, or more. For such service, metal piping and flexible joints offer important advantages. *Non-rigid* type connections can burst instantly without warning, causing injuries to personnel, fire, and waste of valuable oil. *Insurance companies counsel against such hazards.*

In contrast, Barco Swivel Joints are *pressure-safe* and also *fire-safe.* Even if a joint should wear, there is only a slight seeping of fluid —no bursting nor fire hazard. High shock loads can be handled without danger. Barco joints also give more positive hydraulic contol as there is no "mushiness" caused by stretching of hose.

IT'S easy to get the right answer for even your most special hydraulic, steam, or air *piping jobs* when you use this new engineering catalog No. 265A on BARCO SWIVEL JOINTS. It is complete with pictures and diagrams showing correct application and contains all specification data for improved Barco Swivel Joints:

- **Leakproof! Perfect Sealing—Hot or Cold.**
- **No Binding, Low Torque! Trouble-free!**
- **Self-Aligning! Simplifies Installation.**
- **No Lubrication Required! Easy Maintenance.**
- **Economical! Wide Choice of Sizes and Styles.**

SEND FOR A COPY OF NEW CATALOG 265A AND COMPLETE INFORMATION.

BARCO
Manufacturing Co.
521B Hough St., Barrington, Illinois
***In Canada:* The Holden Co. Ltd., Montreal**

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Runout Table Gear Motor

A new gear motor for aluminum and steel mill roll table operations is available from the Westinghouse Electric Corp.

The new gear motor differs from the conventional flexibly coupled, rigidly mounted gear motor, Westinghouse says, in that the driving shaft of the new drive is equipped with a sleeve section that permits direct mounting on the roll shaft extension. The gear motor is provided with a torque rod to anchor the drive and prevent its turning. The torque rod is spring mounted.

Space normally required for motor and coupling connections is saved by using the hollow shaft mounting, and the motor is turned vertically downward. This conserves about 18 in. over the conventional coupled gear motor drive, according to the manufacturer.

Further information will be supplied by Westinghouse Electric Corp., Dept. TP-513, 200 McCandless Ave., Pittsburgh 1, Pa.

Linear Position Transducer

The Northam Model LP-1 Linear Position Transducer, developed by North American Instruments., Inc., converts linear motion or position into a proportional electrical signal for remote indication recording or control. Applications are recommended by the manufacturer in remote measurement and recording in aircraft and engine test work, as well as production inspection and gaging. In one inspection application a Model LP-1 with travel limits of $\pm 1/2$ in. is utilized in an oscillograph recording system to measure solenoid valve stroke within 0.0003 in. over a range of 0.03 in. with time interval between energization and operation being measured within 1 millisec.

The Model LP-1 is based on the magnetic reluctance principle, the moving slide controlling the inductance difference between two coils. The instrument is said to operate in a-c carrier systems from 60 cycles to 10,000 cycles with an accuracy of 1 per cent of the operating range and virtually unlimited resolution. When operated in a bridge circuit the full scale output is ± 40 millivolts per volt and the maximum excitation is 7 volts.

Small size and simplicity are gained, North American says, by allowing the moving slide to project through the case. Slides giving travel ranges from $\pm 1/2$ in. to ± 2 in. are available with the standard 1-in. case size. An alternate model, hermetically sealed for corrosion resistance, is also available for operation in extreme ambient conditions and is recommended for process control and rocket test installations. A portable control unit with indicating meter for 115-v 60-cycle operation featuring 1 per cent voltage regulation and standardizing circuit can be furnished as an accessory. Inquiries should be addressed to Mr. Eugene Bollay, Vice President, North American Instruments, Inc., 2420 N. Lake Ave., Altadena, Cal.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Visual Sequence Annunciator

An annunciator system which automatically indicates the sequence of "off-normal" alarms has been announced by Panalarm Products, Inc. Panalarm Visual Sequence Annunciators are desirable where alarms are applied to closely inter-related variables. In most of these applications, if any one of the variables goes "off-normal," the process shuts down. Thus, with conventional annunciators it would be difficult to determine which variable first went off-normal and caused the shut-down.

Sequence-indicating annunciators indicate the first variable to go "off-normal." This is accomplished either by automatic lock-out of subsequent signals, or by causing the first signal to be red and subsequent signals white. A pushbutton reset feature is also available which causes the sequence indication to start over again.

In addition to use in compressors and process applications where the cause of trouble is sought, sequential annunciators are also advantageous on dangerous processes where operators want to be sure the entire process has shut down when trouble occurs, Panalarm States.

Alarm signals are grouped for sequential lock-out by jumper connections on the rear terminal block, and any number of inter-related groups may be formed or interchanged as desired. All contacts, relays and other moving parts of Panalarm Annunciators are within hermetically sealed plug-in units. Thus, additional signals may be added by adding plug-in units to the common chassis, and the entire system is suitable for Class 1, Division 2 locations, according to the company.

Visual Sequence Annunciator Systems are available in standard Panalarm backlighted nameplate cabinets providing from three to 48 signals. Further information is available upon request to Panalarm Products, Inc., 6312 North Broadway, Chicago 40, Ill.

Countersunk Blind Rivet

Designed for installations where a finished head appearance is of extreme importance, the Southco oval-head countersunk drive rivet is offered as a blind fastening to wood or metal. The rivet is made by South Chester Corp., Southco Div., Lester, Pa.

Oval-head rivets were initially produced for use in attaching moulded plywood to the tubular framework of classroom and institutional furniture. Advantages claimed are: being capable of application from one side of the job, permitting unusual assembly speed, and attaching with a high degree of pull-up exerted in bringing parts together.

Southco Drive Rivets are installed with an ordinary hammer, no special tools being needed to drive the pin which expands four prongs to form a blind head against interior surface. Drive rivets are available in diameters of $^1/_8$, $^3/_{16}$, and $^1/_4$ in., grip lengths varying from $^3/_{32}$ in. to $^5/_8$ in.

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Super-Silvertop
Steam Traps

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THE V. D. ANDERSON COMPANY
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☐ Bulletin 1153 (Heat-Kwik Steam Traps)
☐ Solving Steam Trap Problems (36-page catalog)
☐ Bulletins on Hi-eF Purifiers

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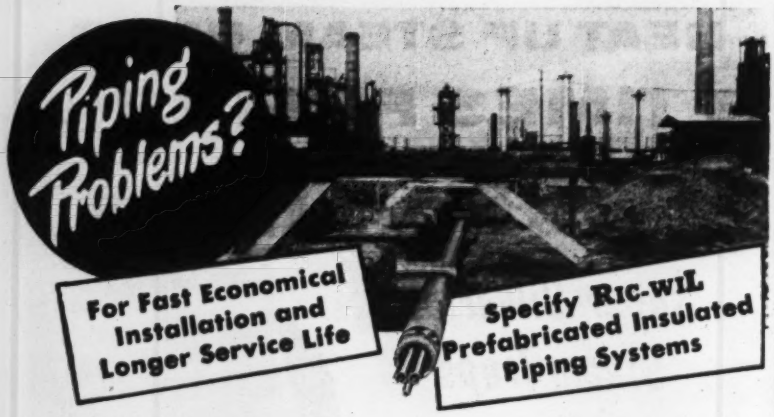
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Regardless of what Martin "Old Kinderhook" Van Buren had in mind when he introduced the term "OK" in the 1840 Presidential campaign, today "OK" has come to mean "well done." And "OK" is what our customers say about the custom gears we deliver to them. Why? Because the combination of attention to details and over 45 years of "know-how" means every gear we produce is a masterpiece of craftsmanship. So specify Cincinnati Gear on your next custom gear order—and you'll put *your* stamp of approval on our gears too.

*Reg. U. S. Pat. Off

THE CINCINNATI GEAR COMPANY

"Gears . . . Good Gears Only"

Wooster Pike and Mariemont Ave. • Cincinnati 27, Ohio

Electronic Air-Cleaner

A new low-cost electronic air-cleaning unit, the PX Precipitron, has been announced available from Westinghouse Electric Corp. Claiming a combination of 90 per cent cleaning efficiency with a push-button method of spray-washing, the new unit is said to cut maintenance costs and eliminate inside-the-duct washing of cells.

Accumulated dirt on the electronic collector-plate surfaces of the unit is flushed away by hot water from needle-spray nozzles attached to a motorized header. After moving slowly across the unit's face, the header automatically reverses and returns to the start position. The same traveling header applies an adhesive oil to the collector-plate surfaces when washing is completed. The oil binds collected dirt together and acts as a solvent for the wash operation.

Height and width of the PX Precipitron unit depend on the cleaning requirements of a proposed system. Power packs and control units are located outside the duct. Typical installations are suggested for industrial plants, office buildings, department stores, food processing plants, and hospitals.

Further information will be provided by Westinghouse Electric Corp., Sturtevant Div., 200 Readville St., Hyde Park, Boston 36, Mass.

Control Valve Offers Unique Construction

C. B. Hunt & Son, Inc., Salem, Ohio, manufacturers of Quick-As-Wink Air and Hydraulic Control Valves, has been assigned the patent for an interior construction for control valves that is claimed to simplify the valve and assure positive positioning of the sealing packers without placing any mechanical pressure on the packers themselves. The patent was granted to S. C. Chessman.

The principal parts consist of a housing with straight through bore; gland nuts for the ends; a hollow radially ported ground and polished stainless steel plunger; internal spacers that are held firmly in metal-to-metal end abutment; and two sizes of O-rings.

In assembly, the O-rings are placed on the shoulders of the spacers, which are then inserted in the housing. Tightening the gland nuts positions the spacers in the housing and holds the O-rings in position.

The manufacturer states that valves using this construction are lower in price than other designs and are available in push-pull, push spring return, hand, foot, cam, diaphragm, pilot, and single or double solenoid operated, with 2-way, 3-way, 4-way or 5-way actions and either open or closed exhaust. They are furnished tapped for either $^1/_8$- or $^1/_4$-in. pipe connections; for use in either air or hydraulic service, pressures to 125 psi, temperatures to 150 F, and also in vacuum service. More complete details and descriptive literature can be obtained by writing C. B. Hunt & Son, Inc., Salem, Ohio.

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Aluminum Gas Meter

A lightweight die-cast aluminum gas meter with a rated capacity of 415 cu ft per hr has been announced by Rockwell Mfg. Co., 400 North Lexington Ave., Pittsburgh 8, Pa.

Similar in body and cover design to two other aluminum meters previously introduced by the company, meters with capacities of 150 and 800 cu ft, respectively, the new "415" weighs only 20 lb as compared with Rockwell's cast iron meters of comparable capacity, which weigh 62 lb.

Like the "150" and the "800," the new meter has a single sealing flange between cover and body, and its valve plate is completely enclosed within the case. It also features oil-impregnated powdered metal bearings. Standing 14 3/4 in. in height by 11 1/8 in. in width and 9 3/8 in. in depth, the "415" has 7-in. spud centers, roll-type diaphragms and four chamber design "D" slide valves with duplex tangent adjustment.

Chief advantage claimed for the new meter is saving in shipping costs and increased ease in handling and installation owing to the reduced weight. Increased resistance to atmospheric corrosion is also cited as an advantage.

Fluid Pressure Cell

A new transducer, the Dynaformer Pressure Cell, has been introduced by The Foxboro Co., Foxboro, Mass., manufacturer of industrial instruments for process measurement and control. The new element converts fluid pressure into a proportional a-c voltage which is measured in terms of pressure by a Foxboro Electronic Resistance Dynalog Instrument.

The Dynaformer Cell consists of a Bourdon pressure spring linked to a copper ring which surrounds the iron core of a differential transformer. Responding to fluid pressure, the spring positions the ring, inducing a differential voltage in the output winding proportional to the fluid pressure.

The cell is accurate to within $\pm 1/4$ per cent at any point and is protected against overrange to 150 per cent of its rating, the company states. Any pressure range between 0 to 30 in. Hg and 0 to 10,000 psi is available.

All parts are enclosed in a splashproof, rubber-gasketed, cast-aluminum case with a pressure-tight cable connection. Electrical components, with the exception of the iron core of the transformer, are embedded in plastic. Three lugs on the case are used for mounting. Complete information, including circuit details and cell specifications, is contained in technical report TI 27-A-12a, copies of which will be sent on request.

Two ways you can protect your family against CANCER

...a check

...a check-up

Cancer strikes in one of every two families. Each year more than 60,000 American children under the age of eighteen lose a parent to cancer.

Yet many cancers can be cured, if discovered in time.

Every man should have a complete physical examination once a year. Women over thirty-five should have a complete physical examination twice a year. Patients are being saved today who could not have been saved even a few years ago.

The American Cancer Society asks your help.

How soon we find cancer's cause and cure depends on how soon and how much help comes from people like you.

Send contribution to Cancer, c/o your local Post Office.

Cancer strikes One in Five
STRIKE BACK...
Give to Conquer Cancer!

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Back-Up Rings

An "SR" series of Kelon-T (Teflon tetrafluoroethylene resin) spiral back-up rings for aircraft and industrial use claimed to protect rubber O-ring seals indefinitely from extrusion, deterioration, or loss of efficiency, has been announced as available from W. S. Shamban & Co., 11617 W. Jefferson Blvd., Culver City, Cal.

Designated series SR-6144, SR-7234, and SR-2619, the new spiral back-up rings have chamfered ends. Spirals with square ends are available in series S-6144, S-7234, and S-2619. The rings are packaged on shipping mandrels and hold their shape in the free condition. With very low friction, the chemically inert spiral packings will not swell, shrink, harden, or soften, and are unaffected by acids, oils, or bases or solvents, according to the manufacturer. Usable temperatures range from minus 110 F to 300 F.

Available in 153 sizes ranging from 0.125 to 15.50 in. ID Shamban Spiral Back-Up Ring packings are interchangeable with AN6246 (6144), AN6244 (7234), and AN6291 (2619) back-up rings. Shamban Spiral dash numbers correspond with AN O-ring sizes. Requests for design information should be addressed to H. A. Traub, W. S. Shamban & Co., Dept. L, 11617 W. Jefferson Blvd., Culver City, Cal.

Lubrication System

A fully automatic oiling system for plain bearings, ball and roller bearings, vees, slides, ways, rollers, cams, chains, gears, and transmissions has been announced by J. N. Fauver Co., Inc., 51 W. Hancock, Detroit 1, Mich., and is identified by the trade name "Oil-Air." Oil-Air has no moving parts, operating on compressed air. Amount of oil flow is adjustable.

A mixture of oil and air is thrust against a reclassifier which reduces it to minute drops of oil which in turn lubricate the bearings. The constant flow of Oil-Air cools and protects the bearings against abrasives and dirt while it lubricates, according to the manufacturer. An Oil-Air system consists of solenoid valve, filter, water separator, regulating valve, lubricator, reservoir, pressure switch, and low-level indicator.

Two-Step Time-Delay Relays

For control circuits requiring two time-delay steps, or momentary impulses, four new time-delay relays have been announced by the AGA Div., Elastic Stop Nut Corp. of America, 1027 Newark Ave., Eliazbeth, N. J. A typical two-step delay application would be the sequential starting of electric motors, the manufacturer explains, and a typical impulse application is the operation of solenoid valves of air cylinders on indexing mechanisms.

The new NET Agastats have adjustable, pneumatically controlled time delay, and an adjustable auxiliary switch which provides two timing steps. The overall time delay is adjustable from 0.1 sec to 10 min or more. The auxiliary switch can be adjusted to operate at any time from 0 to 15 sec after the start of the overall time delay period.

NET-11 and NET-12 Agastats are single-pole, double-throw, double-break switches. NET-21 and NET-22 are double-pole, double-throw, single-break. Relay switch rating is 15 amp at 115 v. Auxiliary switch rating is 10 amp at 115 v.

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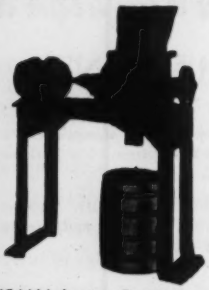

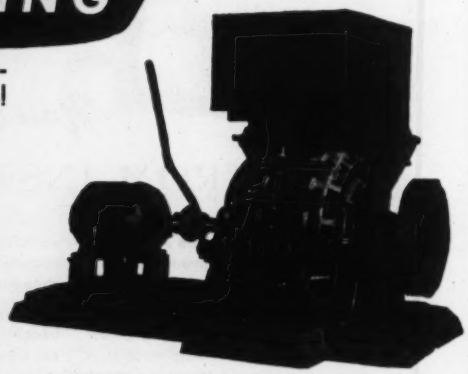

AMERICAN Laboratory Size Mills
With the same reduction action as Metal Turnings Crushers (or hammer action)—American Laboratory Size Mills offer an efficient means for reducing razor blades, pewter castings and fragile thin brittle steel to a reclaim product.

AMERICAN Metals Turnings Crushers
Bulky, hard-to-handle turnings are rapidly reduced as much as 80% with this efficient, economical crusher. And the yield of cutting oil is increased 30 to 50 gallons per ton—proof of how profitable the installation of an American Metal Turnings Crusher can be for those who handle 20 tons or more of metal turnings a month.

There's a custom-built AMERICAN for your operation—write for further data and specifications.

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Totally Enclosed Unit-Cooled D-C Motor

A new totally enclosed, unit-cooled, d-c motor for use in severe atmospheres has been announced by the General Electric Co.'s Direct Current Motor and Generator Dept.

The new motor, smallest standard model of its type, was developed for application in machine-tool, paper, cement, chemical, rubber, and steel-mill industries, and materials-handling operations. Available in ratings from 15 to 200 hp, it features 50 per cent greater heat transfer in a 37 per cent smaller unit than previous designs, according to GE.

The blower motors, standard GE totally enclosed, are for three-phase, 60-cycle power supply. The blower controller consists of a magnetic switch which can, at additional cost, be interlocked with the main controller so that both are started simultaneously.

A thermostatic relay protects the main motor in case of blower-motor failure. Relay contacts can be arranged to cut off the main motor or sound an alarm. Located at the commutator-end air duct, the operating mechanism is accessible from the outside.

The new motors are available in the same speed and horsepower ratings as standard, constant- or adjustable-speed, general-purpose motors.

BUSINESS NOTES

Dravo Moves Heating Department Headquarters

Dravo Corp., Machinery Div., Pittsburgh, Pa., has announced that on October 1, 1953, its Heating Dept. headquarters were moved to the Chamber of Commerce Bldg., 411 Seventh Ave., Pittsburgh 19, Pa.

W. L. Davidson is sales manager of the Heating Dept. The new location has almost twice the floor area available.

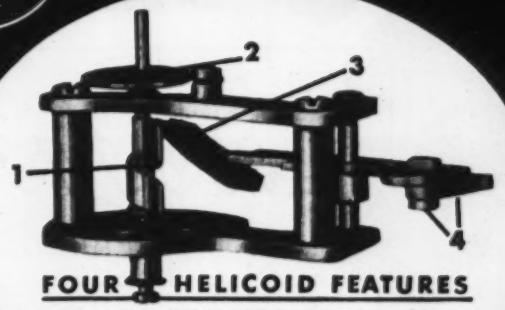
Mobile Abrasive Demonstrator

"Carborundum's Abrasive Workshop," a mobile unit that is equipped to demonstrate coated abrasive grinding under actual production conditions, has been announced by The Carborundum Co., Niagara Falls, N. Y. The traveling Workshop will carry the story of the company's coated abrasive products throughout the country.

The vehicle is 35 ft long and 12 1/2 ft high, and contains the means for showing the abrasive products in use. Eight stationary coated-abrasive grinding machines and a variety of portable tools have been installed in the 19-ton Workshop. The expanding sidewall of the vehicle, increases the effective width of the Workshop to a total of 15 ft when the unit is stationary.

ACCO products

HELICOID GAGES



FOUR HELICOID FEATURES

1. Stainless Steel Helicoid Roller (no gear teeth)
2. Stainless steel hair spring
3. Long Life Cam (no gear teeth)
4. Corrosion-resistant link and screws

Why HELICOID Gages...

retain original accuracy longer, last longer, and cost less per gage, per year

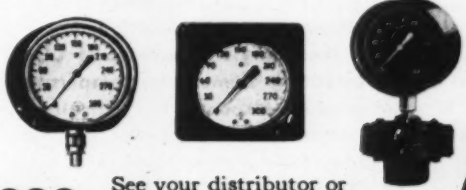
NO GEARS, NO TEETH

• HELICOID is the greatest achievement of the gage makers' craft—the pressure or vacuum gage *without gears... without teeth!* The HELICOID movement is a simple cam and roller device that gives long, trouble-free service. It has been tested and proved in years of hard service in the field.

HELICOID Gages are particularly desirable where pressures fluctuate and cause excessive movement and wear of gears in ordinary gages. The smooth operation of the durable HELICOID cam and stainless steel roller keeps the pointer as steady as it was originally even after hundreds of thousands of cycles.

Many sizes, many styles

You can get HELICOID Gages for pressure, vacuum, or compound service—in all pressure ranges; white, black, or radiant faces; wall, stem, flush, and panel mountings, or flangless cases.



ACCO

See your distributor or write today for **Catalog G-2**

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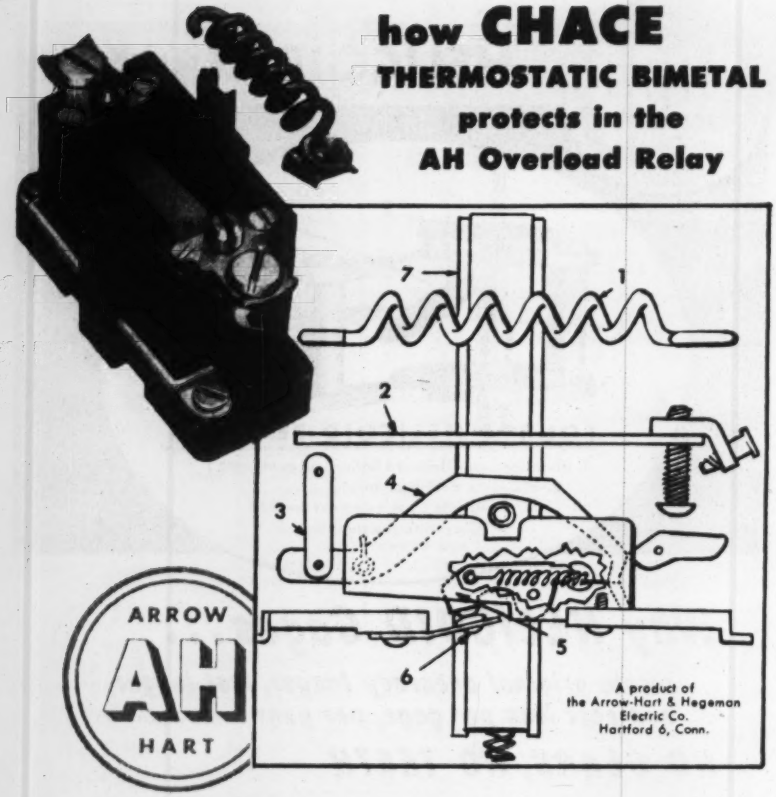
HELICOID Pressure • Vacuum GAGES



An element of Chace Thermostatic Bimetal actuates the Arrow-Hart overload relay to provide protection to electric motors when overloaded, when polyphase motors are single phase operated, or when extremely low voltage exists in the power line. The AH thermal overload relay shown is used in conjunction with a magnetic starter switch.

When an overload on the line occurs for any reason, heater element (1) causes bimetal element (2) to bend, and through link (3) depresses left end of lever (4). A coil spring attached to the opposite end of the lever and to breaker arm (5) holds breaker arm in contact position under normal conditions. When deflection of the bimetal moves lever, the spring is raised above dead center and arm is caused to snap upward, separating silver butt contact points (6).

To reset relay, slide (7) is depressed and pin in slide forces breaker arm down to contact position, moving spring past dead center and returning lever to operating position. Latch (8) locks spring loaded end of lever under operating condition.

This illustrates but one of the many applications of Chace Thermostatic Bimetal as the actuating element for temperature responsive devices. If your product responds to, indicates or controls temperature changes, actuate it with dependable Chace Thermostatic Bimetal. Write today for our new 36-page booklet, "Successful Applications of Chace Thermostatic Bimetal," containing condensed engineering data.

Sarco Opens San Francisco Office

Sarco Co., Inc., New York, N. Y., recently established a new sales office at 35 Elmira St., San Francisco, Cal. This branch office represents Sarco exclusively in northern California. Sarco Company, Inc., manufactures steam traps, temperature regulators, and heating specialties.

Mr. J. S. Spear is sales manager of the new branch office. He has been associated with Sarco Co., Inc. for over 15 years, serving as sales engineer in the New York territory.

Trimount Purchases Crown Controls, Inc.

The Trimount Instrument Co. of Chicago, Ill., has announced that they have purchased Crown Controls, Inc., Detroit, Mich., manufacturers of Hydro-trol. In the future the Hydro-trol Controls will be manufactured and sold by the Crown Control Div. of the Trimount Instrument Co. at 3119 West Lake St., Chicago. The same special features of Hydro-trol will be maintained and improved, Trimount states. Literature describing the Hydro-trol by Trimount will be sent on request.

Cleaver-Brooks Obtains North American Rights of Escher Wyss

Broad sales and manufacturing rights for the North American continent have been granted the Cleaver-Brooks Co., Milwaukee, Wis., by Escher Wyss Co. of Zurich, Switzerland.

Cleaver-Brooks Co., founded in 1932, manufactures self-contained (packaged) steam boilers, distillation equipment, industrial oil and gas burners, and bituminous heaters. The company operates two plants in Milwaukee and a wholly-owned subsidiary, Michael Yundt Co., in Waukesha, Wis. At the Michael Yundt facility, the company is engaged in the manufacture of bottle washers and pasteurizers.

In anticipation of expanded production, Cleaver-Brooks is pressing new construction at its main plant in Milwaukee to ready approximately 50,000 sq ft of factory space and extensive tooling to handle manufacture of the new lines and also to effect certain consolidations. Production of these new lines is scheduled to start in the last half of 1953.

Escher Wyss Ltd., founded in 1805, designs and manufactures hydraulic turbines of Kaplan, Francis, and Pelton type, pumps, steam and gas turbines, centrifugal and axial flow compressors, heat exchange apparatus, and evaporation equipment. Escher Wyss operates plants at Zurich, Switzerland; Ravensburg, Germany; Schio, Italy; and Boksburg, South Africa.

The arrangement between the two companies will entail the Americanization of Swiss designs, and the establishment of sales and service organizations.

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Rotary Lift Appoints Western Distributor

Rotary Lift Co., Memphis, Tenn., designers and builders of hydraulic lifting devices, has announced the appointment of The Rucker Co., Oakland, Cal., as distributor of their industrial lifts for the states of Washington, Oregon, Idaho, Nevada, and Arizona.

The Rucker Company, with branches in South Gate, Calif., and Seattle, Wash., has specialized in sales of hydraulic equipment for many years. Among the Rotary materials handling devices it will distribute are Leva-Dock Ramps for loading docks, Levelator material lifts, Factory Truck Lifts, Transfer Bridges, and Lumber Lifts.

Movie on Aluminum Welding

A demonstration of techniques in the welding of aluminum pressure vessels is a feature of a new color welding film available from Aluminum Co. of America.

The 28-minute 16-mm film, "Welding Advances With Aluminum," offers a description of welding aluminum using both the tungsten-arc and consumable-electrode methods. The basic concepts of both tungsten-arc and consumable-electrode welding are explained in an animated sequence.

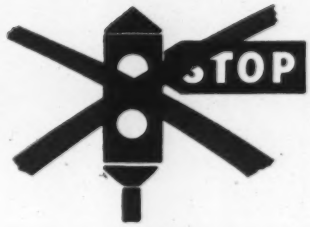
Described in the film are the services of Alcoa's research and process development facilities which are offered to customers for the solution of their welding problems. The viewer is taken on a brief tour of these facilities which include the Aluminum Research Laboratories and Alcoa's Joining Process Development Laboratory.

"Welding Advances With Aluminum" can be borrowed for group showings. Requests for prints should be made on business letterhead to Motion Picture Section, 818 Alcoa Bldg., Pittsburgh 19, Pa.

Lamson Acquires Mobilift Fork Trucks

Lamson Corp. of Delaware has announced recently the acquisition of the fork lift truck business of Mobilift Corp., of Portland, Ore. A new Oregon subsidiary, Lamson Mobilift Corp., will take title to the assets being purchased and carry on the fifteen-year-old business as an integral part of the Lamson line of materials handling equipment.

Lamson manufactures belt and roller conveyors, the Automatic Pallet Loader, pneumatic tubes, blowers, and related types of materials handling equipment. With the addition of Lamson Mobilift fork trucks, Lamson has stated that it can offer to industry the first integrated system for handling packaged products from the sealing machine through to the shipping platform into trucks or cars or into storage, including a logical choice between conveyors and fork trucks for any application, as well as the proper balance between the two materials handling techniques.



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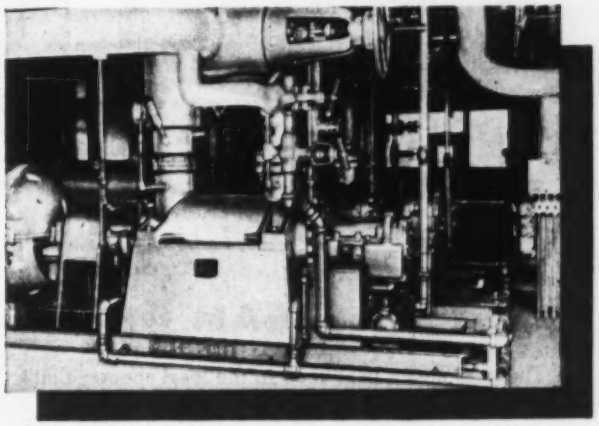
Provide Constant Power Generation Traffic!

Electric power generation and transmission are geared to continuous, indefinite operation. A vital link in keeping this electrical energy on the GO is Pacific boiler feed pump installations – both operating and standby. For more than two decades, Pacific has built feed pumps for this exacting service in central stations and industrial power plants on four continents.

Sizes installed range from the midgets of less than 50,000 lbs. per hour to the giants having a capacity of 1,000,000 lbs. per hour. The operating discharge pressures range from 200 to 2500 psig. More than 50 units are operating at discharge pressures above 2000 psig.



To insure GO in your central station or industrial power plant, specify boiler feed pumps by Pacific Pumps, Inc. For more information, write for Bulletin 109.

PACIFIC *Precision Built* PUMPS

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UP TO
30,000 pounds of Steam
per hour from this modern TITUSVILLE package unit

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STEAM GENERATOR

The most steam produced in the least space—that's the measure of efficiency and simplicity of design and performance in our modern WTP Steam Generator. This water tube package unit is shop-assembled, furnished in a range of capacities from 7500 pounds of steam per hour, and is adapted for firing with all oil and gas fuels and their combinations. Write for Bulletin B-3275 on this compact steam package, today!

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Dravo Moves New York Office

Dravo Corp., Pittsburgh, Pa., has announced that its New York City office is now located at 19 Rector St., New York 6, N. Y., telephone HAnover 2-6653.

The New York office is under direction of Walter Barrett, district manager.

Key Co. to Distribute Phillips Rotary Joints

Key Co. of East St. Louis, Ill., manufacturer of fittings and flanges for alloy steel industrial piping systems, has been appointed distributor of Phillips Rotary Joints, it has been announced by Phillips Rotary Joint & Valve Corp., West New York, N. J.

Further information on the new Phillips Rotary Joint may be obtained by writing to Key Co., 27th & McCasland Ave., East St. Louis, Ill.

Cleaver-Brooks Names Western Distributor

The Cleaver-Brooks Co. of Milwaukee, Wis., has announced the appointment of Hathaway-McCartney Engineering & Supply Co., Denver, Colo., as exclusive sales agent for Cleaver-Brooks Self-Contained Boiler Equipment.

The partnership consists of C. M. Hathaway and B. A. McCartney. The firm is located at 1459 South Pearl St., Denver 10, Colo. Hathaway-McCartney will handle a territory that includes Colorado, southeastern Wyoming, western Nebraska, and western Kansas.

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UNITED CEREBRAL PALSY
YOUR HELP IS THEIR HOPE!
GIVE TO YOUR LOCAL AFFILIATE

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Allis-Chalmers Operates Buda

The Allis-Chalmers Mfg. Co. has assumed operation of The Buda Co., 72-year-old Harvey, Ill., firm, according to W. A. Roberts, Allis-Chalmers president. The addition is being operated as "The Buda Co., a division of Allis-Chalmers."

Ralph K. Mangan, with Buda for 36 years and president since 1950, will be in charge of the division with the title of president and general manager.

Transfer of the assets of The Buda Co. to Allis-Chalmers was at the rate of one share of Allis-Chalmers common stock for each 2⅛ common shares of The Buda Co.

Film on Mechanical Seals

A 20-min, full-color film on mechanical shaft seals for centrifugal pumps is now available through Byron Jackson Co. Designed for showings to engineering and maintenance meetings, this film covers mechanical seals from design to maintenance. Various seal types and their applications are described. Seal operation is graphically illustrated by animated drawings.

Arrangements for film showings can be made by contacting L. C. Kimball, Byron Jackson Co., Los Angeles 54, Cal. Also available is a condensed transcript of this film in bulletin form, complete with photographs and drawings, BJ Bulletin No. 153-10,000.

LATEST CATALOGS

Cable Subway Ducts

"Transite Ducts" is a 12-page brochure issued by Johns-Manville. It covers installation and maintenance information on Transite Conduit, for exposed work and installation underground without concrete encasement, and Transite Korduct, for installation in concrete. Illustrated, the brochure cites many typical examples from public utilities, telephone companies, and other industries which show how Transite duct materials can cut cable subway costs.

Copies of "Transite Ducts" are available from Johns-Manville, 22 East 40th St., New York 16, N. Y.

Air Heater

Peabody Engineering Corp., New York, N. Y., has released a six-page Air Heater Bulletin. Printed in seven colors, the new bulletin describes in both text and flow diagrams the operation of the Peabody Air Heater, and typical applications. As a means of pressure-controlled combustion, according to the company, the Peabody Cylindrical Furnace Air Heater is used in the process industries for spray drying, liquid concentrating, rotary drying, and petroleum refining.

BIDDLE *Instrument News*

NEW...

SPEED MEASURING BOOKLET For PRACTICAL MECHANICAL MEN

Cut-away drawings show how the phenomenon of resonance is applied to the measurement of speed through the use of a set of tuned steel reeds mounted in a case with a scale calibrated in rpm. Complete range of instruments is described.

IF YOU WANT QUICK, ACCURATE READINGS *WITH SAFETY*

Don't overlook the advantages of FRAHM® RESONANT REED TACHOMETERS for hand or permanent mounting. *No contact with moving parts is required.* Just touch the instrument to the chassis, frame or housing of the machine or motor and read the rpm directly.

There are no moving parts, hence no lubrication or maintenance is required. Accurate to ½ of 1%, they will operate continuously for years without any appreciable change. Instruments with limited ranges available for as little as $27. Practically any desired range within 900 and 100,000 rpm can be supplied.

Write for **BULLETIN 31P8-ME.**

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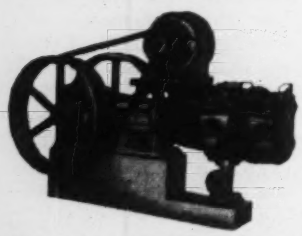
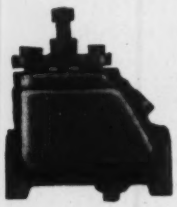
To Be Sure

of Fast Friendly Service | *on Pumps and Compressors*

Specify UNITS *By* **PENNSYLVANIA**

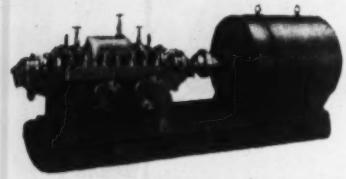


OILFREAIR & OILFREGAS Compressors Class ATL with steel-backed carbon cylinder-liners. Guaranteed to compress free of any trace of oil or oily vapors. Bulletin 600-10



AIRCHEK VALVE Automatically prevents reverse flow through Compressor and also dampens pipe line pulsations.

This Check Valve should be on EVERY reciprocating Compressor. Bulletin 509-10



PENNSYLVANIA 6-Stage Type OHB THRUSTFRE Pump for Boiler Feeding. Bulletin 242-10

YOUR Copy of Catalog 546 briefly describes All PENNSYLVANIA Products. Write For It Today.

PENNSYLVANIA
Pump & Compressor Co.
EASTON, PA.

OILFREAIR® OILFREGAS® THRUSTFRE® AIRCHEK®

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Silicon Carbide

"Facts About Silicon Carbide" is a 52-page brochure prepared by the Research & Development Div. of the Carborundum Co., Niagara Falls, N. Y., and offered to those interested.

A brief history of silicon carbide and the Carborundum Co. is given, and the properties of the material are discussed, with particular reference to varying uses to which it may be put. Manufacturing techniques are outlined. A bibliography completes the booklet.

Reproduction Materials

Information on the characteristics of Kodagraph reproduction materials are provided by the Eastman Kodak Co.'s publication "Modern Drawing and Document Reproduction."

Sections on Kodagraph Projection Positive Paper and Kodagraph Microprint Paper have been added to the booklet. Data on sheet sizes, roll sizes, and packings have also been incorporated for all products covered. The booklet is available without charge from Industrial Sales Div., Eastman Kodak Co., Rochester 4, N. Y.

Wrought Iron Nipples

"Wrought Iron Nipples" is the title of a folder prepared by A. M. Byers Co. to help technicians complete wrought iron piping specifications.

The folder explains how to identify wrought iron nipples and contains a full page of size and dimensional data. Separate tables list stock sizes and lengths in inches of standard weight and extra strong nipples. Listings include nominal size, close nipples, special short, short, long, and extra long lengths of both black and galvanized nipples.

Copies of the "Wrought Iron Nipples" bulletin can be obtained by writing A. M. Byers Co., Clark Bldg., Pittsburgh, Pa.

Solids Contact Water Softener

A comprehensive 24-page bulletin on its Solids Contact Reactor for clarifying or lime softening of water, or both, has been published by the Cochrane Corp., 17th St. below Allegheny Ave., Philadelphia 32, Pa.

This catalog defines the major advantages of the Solids Contact principle, gives the eight basic requirements for sound Solids Contact Reactor design, and shows how these features are incorporated by Cochrane. It illustrates the basic reactor types that can be supplied: round or square units with vertical shaft agitator, and rectangular units with horizontal shaft agitator. Reactors can be made of concrete, steel, or wood, or combinations of these materials. Chemical feed and auxiliary equipment also are described. Copies of this publication, No. 5001-A, are available.

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Insure your future with North American Aviation. The Engineering Department has challenging openings for engineers with aircraft experience, for recent grads... for men from other fields with adaptable experience. Twenty-five years of engineering vision and expansion and long term military projects secure your future. Openings now in:

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NEW EQUIPMENT
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Cyclonic Combustion Described

Cyclotherm Div., United States Radiator Corp., Oswego, N. Y., has issued a pamphlet explaining the principles of their patented method of Cyclonic Combustion. Descriptive drawings in the booklet show how air is introduced into the Cyclotherm combustion chamber at high speeds in a revolving spiral vortex, radiating heat to the fire tube through direct radiation and convection. This is said to result in an unusually high rate of heat transfer.

The leaflet says that because of the high rate of heat transfer developed through the use of the patented Cyclonic Combustion principle, Cyclotherm engineers have cut down the necessary heating surface to 3 sq ft per boiler horsepower. The booklet also explains how this was made possible.

The new pamphlet, titled "All Your Questions Are Answered by Cyclotherm," is available by writing Cyclotherm, Oswego, N. Y.

Pneumatic Signal Transmitter

Bulletin No. 2553, issued by Hagan Corp., Pittsburgh, Pa., illustrates and describes a heavy-duty pneumatic signal transmitter for use in measuring, indicating, and controlling fluid flow and liquid level at operating pressures up to 1500 psi and pressure differentials up to 100 psi for steam generation and process control.

Featured in the eight-page booklet are: (1) design details which give the transmitter a linear-flow characteristic said to eliminate the need of additional square root extractors in the totalizing equipment; (2) construction details of the several differential elements available; (3) method of calibration, either under full static conditions or atmospheric pressure; (4) advantages of being able to operate without sealing fluids; (5) economy in operating-air consumption. Also included are application sketches and explanations. The bulletin will be sent on request.

Silicone Rubber Stock

Dow Corning Silastic Facts No. 9-332 discusses the properties and applications of Silastic 675, a silicone rubber material. According to the manufacturer, it has the lowest long-term shrinkage of any silicone rubber stock, the lowest compression set values of any silicone rubber with nontoxic additives, and physical strength superior to ordinary silicone rubber stock. In addition it is said to be an extreme-temperature material serviceable at temperatures from −100 F to 500 F.

Silastic Facts No. 9-333 concerns Silastic 132 (formerly Silastic X-2001), a silicone rubber paste for coating glass cloth or organic fabrics.

Both publications are available from Dow Corning Corp., Midland, Mich.

the **new**

Type "DE"

Coffin turbo pump

Superbly engineered to keep pace with increasing steam pressures, the new type "DE" is a highly efficient single-stage, high-speed, steam turbine-driven centrifugal boiler feed pump.

At *no extra cost,* unit is equipped with both a *speed-limiting governor* and a *pressure regulator* operated by a powerful oil relay which prevents over-speeding and provides shut-down upon loss of oil.

The unit has varied industrial uses, particularly in the oil and chemical fields for boiler feed and other services. The pump covers a Volumetric Range to 800 GPM, Discharge Pressure to 1000 PSIG, Steam Temperatures to 850° F., Exhaust Pressures to 80 PSIG, and Liquid Temperatures to 325° F. For special installations these ratings can be exceeded.

Write for the new, 6 page illustrated "DE" Bulletin ME 154.

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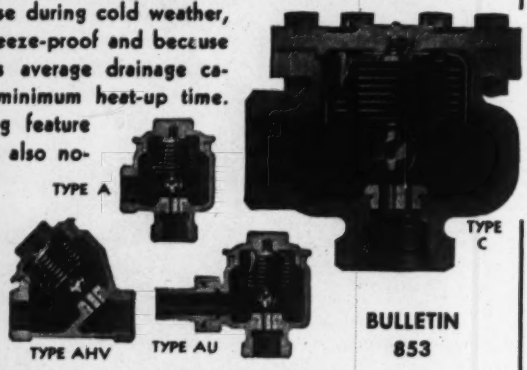
NICHOLSON MAKES

Freeze-Proof Steam Traps

for every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Types for every plant use. Size ¼" to 2"; pressures to 250 lbs.



BULLETIN 853

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W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

ENCO DUAL FUEL-OIL Heating and Pumping Set

Two heaters and two pumps—one steam, one electric driven—in one set with these six features:

1. Completely automatic operation with temperature and pressure regulation.
2. All essential equipment—including safety valves as needed—in one compact unit.
3. Individually designed to meet the specific needs of the power plant.
4. All parts visible and accessible for easy operation, maintenance and repair.
5. Pumps run at moderate speed. Heaters designed to give the correct viscosity and velocity without fouling.
6. Cleaner boiler room . . . all overflows connected to a common outlet, flanged drip pan for pumps catches oil drip.

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Fixed-Position Rotating Blower

Bulletin No. 1137 has been published by Diamond Power Specialty Corp., Lancaster, Ohio. It gives information on the Model G9B Blower, said by Diamond to be the most widely used of all their types. It employs a fixed-position rotating element to clean a large number of tubes by sweeping through a predetermined arc. The bulletin suggests the various uses for boilers, superheaters, reheaters, economizers, heat exchangers, oil stills, etc.

Model G9B is available for three pressure ranges up to and including 1500 psi. It may be manually operated, or driven by electric or air motor. It can be converted to automatic sequential operation.

Automatic Scales

Bulletin No. 0252 describes the operations and facilities of the Richardson Scale Co., manufacturers of automatic weighing, bagging, and proportioning equipment. With photographs and text the bulletin describes the Richardson plant, engineering services, development facilities, sheet iron department, machine shop, tool room, assembly, tests and inspection, customer service, and foundry. Typical applications of Richardson equipment in bulk weighing, continuous weighing, blending, automatic bagging, compounding, power production, automatic liquid weighing, belt feeders, proportioning, and accessories are shown.

Copies of the 32-page Bulletin No. 0252 are obtainable from the Richardson Scale Co., Clifton, N. J.

Multi-Stage Centrifugal Pumps

Ingersoll-Rand has published an 18-page, three-color bulletin on the Class CNTA multi-stage centrifugal pumps. It incorporates sectional drawings, installation views, and a two-page chart showing the interchangeability of parts throughout the CNTA line.

These units, specifically designed for boiler feed, refinery, process work, and mine pumping services, are now available for all pressures from 300 to 1000 psi with capacities to 700 gpm, the company has announced.

Copies of this bulletin, Form 7251, are available from I-R branch offices or Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Metal Weight Calculator

An alloy and steel weight calculator for the metal-working industries has been designed by Continental Copper & Steel Industries, Inc., for distribution by its various divisions in the metal-working field.

Through manipulation of a slide, the CCS computer provides weights of strips, sheets, bars and plates of various metals and alloys. Factors are given for steel, stainless steel,

nickel, monel, inconel, aluminum, hasteloy, copper, and titanium. On the reverse side is a condensed version of specifications in the ASME Code for the fabrication of pressure vessels. The computer is constructed of heavy cardboard.

The device is available through Alloy Fabricators Div., Perth Amboy, N. J.; Braeburn Alloy Steel Div., Braeburn, Penna.; Niagara Falls Smelting & Refining Div., Buffalo, N. Y.; Walsh Holyoke Boiler Works Div., Holyoke, Mass.; Welin Davit & Boat Div., Perth Amboy, N. J.; or the main office of Continental Copper & Steel Industries, Inc., 345 Madison Ave., New York 17, N. Y

Pipe Data Card

A new data card, designed to be of assistance to those involved in the selection, application, and installation of carbon, alloy, and stainless steel pipe, has been issued by the Tubular Products Div. of The Babcock & Wilcox Co.

Known as TDC 138 A, the data card contains information on dimensions, weights, specifications, grades, and analyses of seamless and welded carbon, alloy, and stainless steel pipe. It presents pertinent data on six pipe size schedules and complete reference data to steels covered by ASTM and ASME piping specifications. Copies of this data card are available free upon request to the sales offices of the Division at Beaver Falls, Pa.

Surface Roughness

An illustrated four-page bulletin entitled "How to Win Arguments on Surface Roughness" has been announced by Micrometrical Mfg. Co.

This bulletin presents the basic reasons for disagreement on surface roughness and explains why it pays to end them from the standpoint of the machine operators, production supervisors, inspection department, engineering department, and plant management.

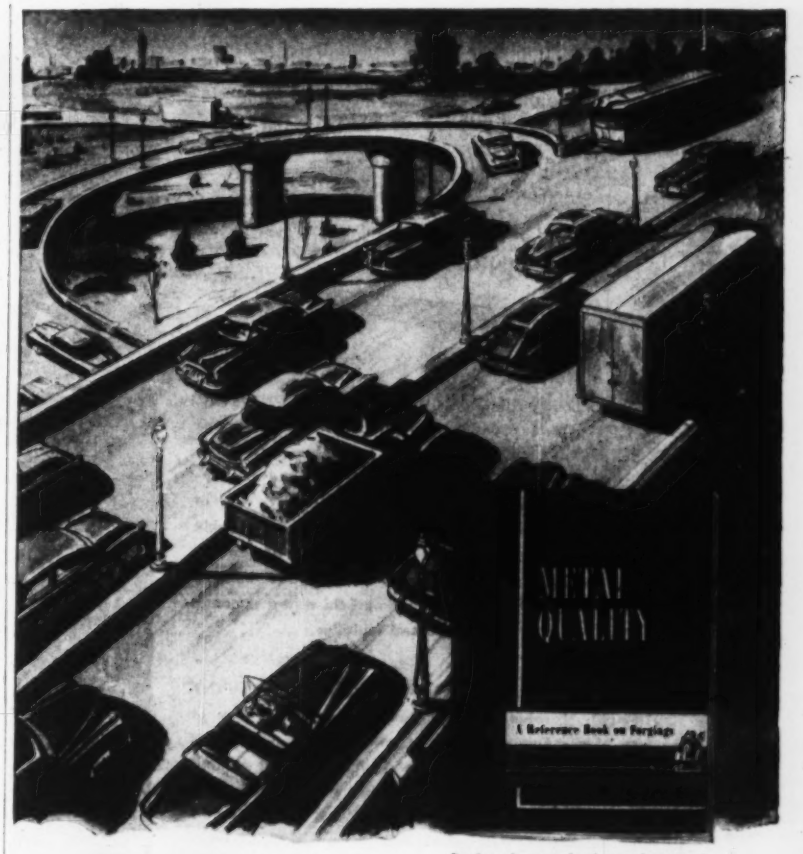
Copies of the bulletin are available on request from Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor, Mich., asking for Bulletin LT85.

Sewage and Sump Pumps

An eight-page bulletin has been published by American-Marsh Pumps, Inc., on sewage and sump pumps.

The bulletin describes three types of pumps: the NKS Vertical Wet Pit Single or Duplex; the NKV Vertical Dry Pit; and the NKH Horizontal. Specifications are given for all types and optional equipment is illustrated and explained.

Performance tables and dimension drawings are supplied. Materials used and design of the pumps are explained. Copies of the bulletin can be obtained from American-Marsh Pumps, Inc., Battle Creek, Mich., requesting Bulletin No. 325-A 34.



Engineering, production and economic advantages obtainable with closed die forgings are presented in this Reference Book on Forgings. Write for a copy.

This Book Reveals the Matchless Capacity of Forgings!

That makes possible Modern Transportation

What a forging *has*—can't be duplicated! No other method of fabricating parts utilizes fully the fiber-like flow line structure of wrought metals. Now is an excellent time to check your product for cost reductions—to explore possibilities for improving performance—to reduce dead weight. Check problem parts with the unrivaled advantages of closed die forgings and the closed die forging process for producing parts. Double-check all parts, particularly those which are subjected to great stress and strain. Then consult a Forging Engineer about the correct combination of mechanical properties which closed die forgings can provide for your product.

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Please send 64-page booklet entitled "Metal Quality—How Hot Working Improves Properties of Metal", 1953 Edition.

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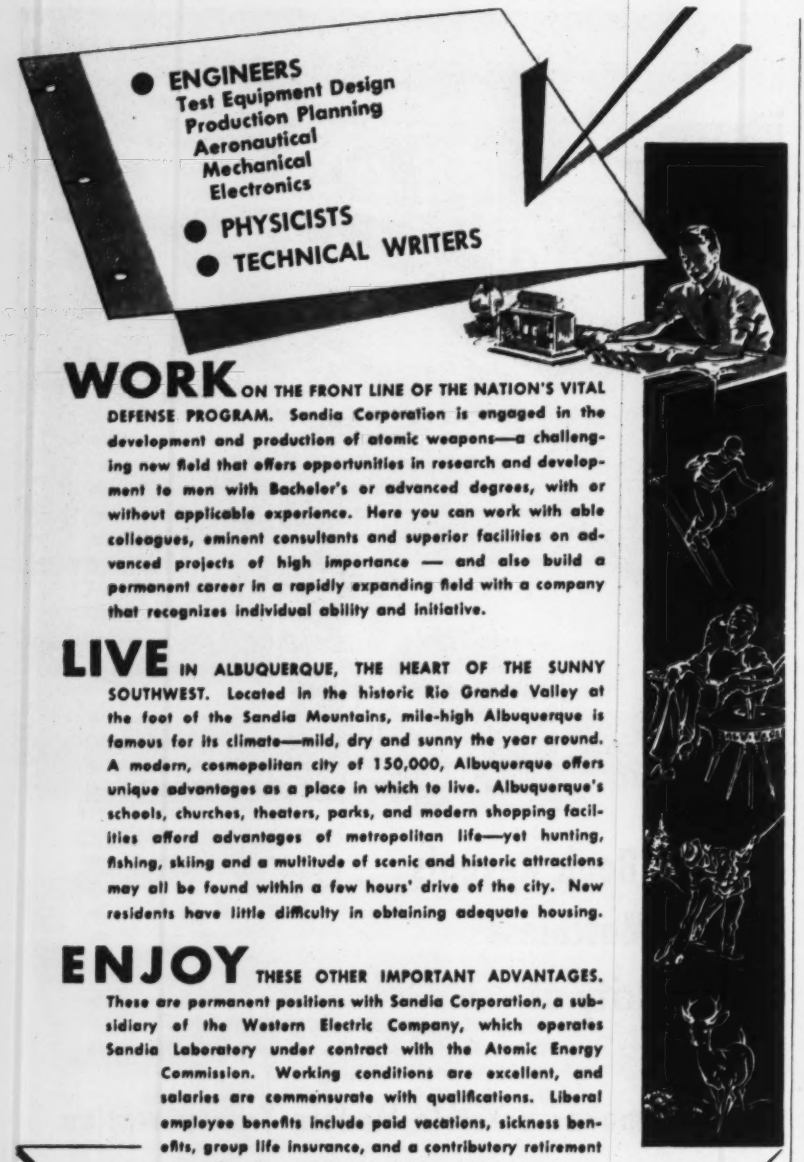

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ENJOY THESE OTHER IMPORTANT ADVANTAGES. These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates Sandia Laboratory under contract with the Atomic Energy Commission. Working conditions are excellent, and salaries are commensurate with qualifications. Liberal employee benefits include paid vacations, sickness benefits, group life insurance, and a contributory retirement plan. This is not a Civil Service appointment.

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KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Refinery Process Burner

Peabody Engineering Corp., New York, N. Y., has published a bulletin covering their line of Type MU Combination Gas and Oil Burners and Type S Vertically or Horizontally Fired Premix Gas Burners for Process Furnaces.

The four-page folder, designated Bulletin 703-A, describes the construction features of both burners. The bulletin may be obtained by writing directly to Peabody Engineering Corp., 580 Fifth Ave., New York 36, N. Y.

Low-Differential Flow Meter

An eight-page booklet describes the Hays Diaflow Meter, and gives important data on this meter for measuring air flow, gas flow, and the ratio of air flow to gas flow. It is recommended by the manufacturer for industrial furnaces, sewage disposal plants, and cost accounting.

The meter employs the pilot method of operation, dry diaphragm-type measuring element, and package unit construction. Several models are available to fit most requirements. Publication 52-1017-37, the booklet, will be sent on request by the Hays Corp., Michigan City, Ind.

Flow Signal Transmitter

Bulletin 2653, issued by Hagan Corp., Pittsburgh, Pa., illustrates and describes a combination 1500-psi liquid line-flow measuring element and pneumatic flow-signal transmitter equipped with square root extraction cam for linear indication, recording, or control of furnace fuel and process liquids.

Design features discussed and advantages claimed in the four-page booklet include (1) the advantages obtained by using an integrally constructed measuring orifice with differential-pressure bellows that requires no sealing fluids; (2) simplicity of checking the instrument by dead-weight calibration; (3) accuracy of better than 1 per cent of full-scale reading; and (4) sizes of measuring elements up to 2000 gal per hr.

Thermistors

Information on methods of using thermistors, heat-sensitive electrical resisters with negative temperature coefficient, as well as a description of a new physical demonstration of permanent magnet properties, is available in four technical data sheets, TH-9, TH-10, TH-11, and PM-116, issued by Carboloy Dept. of General Electric Co.

The reports describe thermistor applications in radio set surge protection (TH-11), contactless switches in over-load protective devices (TH-11), temperature compensation (TH-10), warning signals (TH-9), and controlled automation (TH-9). They each include manufacturing, operating, selection, and engineering assistance data.

The report on magnetic principles (PM-116) discusses magnetic suspension, torque control, driving, and braking with permanent magnets.

Over 85% of the torque wrenches used in industry are

STURTEVANT
TORQUE WRENCHES
Read by Sight, Sound or Feel.

- Permanently Accurate
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in inch ounces . . . inch pounds . . . foot pounds (All Sizes from 0-6000 ft. lbs.)

Every manufacturer, design and production man should have this valuable data. Sent upon request.

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NEW EQUIPMENT
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Heating and Power Equipment

A general catalog of commercial-industrial automatic heating and power equipment has been released by Petro, 3170 West 106th St., Cleveland 11, Ohio. Schematic drawings, layouts of typical installations, cutaway views of burners and burner parts, and photographs of burners and installations are included among the illustrations. Specifications and detailed data on exclusive features of Petro oil, gas, and combination oil-gas burners are given. Catalog, Form 3048, is available without charge from manufacturer.

Selection of Shears

Selecting, setting up, and operating Di-Acro Shears are described and illustrated in a 14-page booklet available upon request from O'Neil-Irwin Mfg. Co., 569 Eighth Ave., Lake City, Minn.

The booklet points out different materials that can be sheared, from plastics, fiber, mica, leather, and rubber to heavy gages of aluminum, chrome molybdenum, leaded brass, stainless steel, and other spring-tempered materials.

In addition, all specifications and capacities are listed in tabular form on four hand- and four power-operated precision shears which have a material capacity of 16-gage mild sheet steel.

Space-Heater Applications

Case Study No. 560-62, issued by Dravo Corp., Pittsburgh, Pa., describes how gas-fired warm-air space heaters were positioned on the floor and suspended overhead to provide uniform comfort heating for an automotive spare-parts depot.

The four-page folder describes the advantages derived from this method of heating as (1) even heat distribution over and around stacked material; (2) conservation of floor space; (3) satisfactory heating with minimum number of units; and (4) automatic operation which eliminated the need of attendants. Copies will be sent on request.

Gear Speeders

Having recently added two new machines to its line of gear speeders, Michigan Tool Co. has issued a four-page bulletin, Bulletin No. MS-10, covering the complete line of these machines now available.

Four gear-speeder models are covered in the new bulletin. They are Models 1126 and 1126-A, designed primarily for testing automatic transmission gears; and Models 1127-B and 1129, for checking mating gears. Model 1129 is said to be particularly suitable for testing larger-size gears. Each gear speeder's operation, control, and specifications are covered in the new bulletin. Illustrations of the complete line of machines are also included. Bulletin MS-10 may be obtained by writing to Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

Dollars fly away when your CHIMNEY is not efficient!

Have fuel costs mounted beyond reason? Do you have all the power you need at all times?

When new boilers have been added or power conditions increased, it frequently happens that the load on the chimney is built up to a point where the chimney no longer permits efficient operation . . . fuel costs mount, power lags, and the whole plant suffers.

It is time to check on your chimney. A Consolidated engineer will inspect your chimney at no inconvenience to you and make specific recommendations to lower your costs and increase operating efficiency.

This service places you under no obligation. Make use of it today or

Write for Literature on Building and Repair Service.

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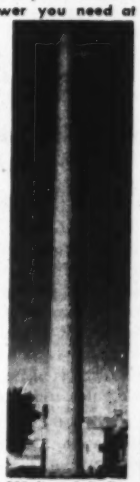

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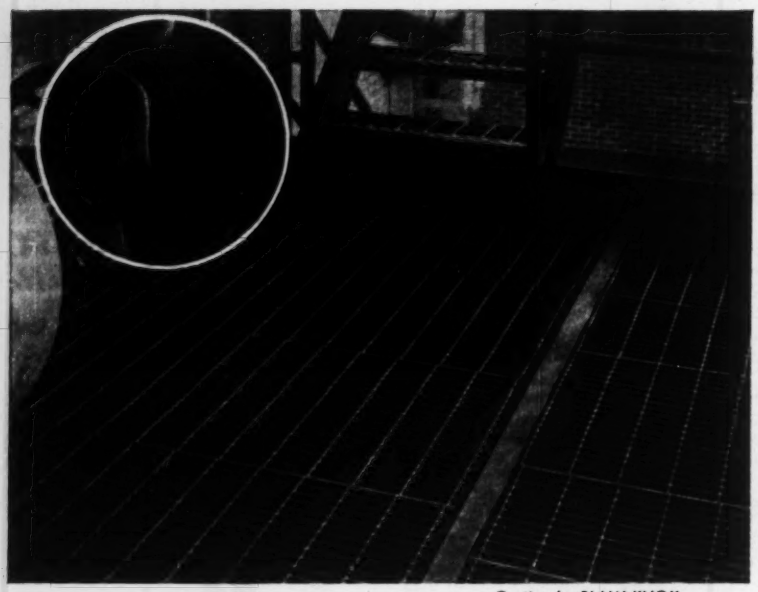

Grating by BLAW-KNOX

where can you use steel grating?

You undoubtedly use a lot of steel grating in your plant—floors, platforms, walkways, catwalks and stair treads, for example.

But how about grating for fan guards and shelving—for covering open pits and light wells? And how about other uses throughout your plant that no one has thought of—as steel grating is adaptable to many uses.

If you have any problem about a common application or an unusual application or a possible application, we'll be glad to hear from you. And to give you a prompt answer.

Only Blaw-Knox Electroforged® Steel Grating and Stair Treads —have these five exclusive features:

1. **rigid one-piece construction—easy to install**
2. **all surfaces accessible—easy to paint**
3. **no sharp corners to clog—self-cleaning**
4. **maximum open area—for light and ventilation**
5. **non-slip twisted crossbar—safe footing**

A short note will bring you a copy of new Bulletin No. 2365-R —a dimensional sketch will bring you a quotation.

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BLAW-KNOX EQUIPMENT DIVISION
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GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Castings by Shell Molding

Builders Iron Foundry has released a four-page bulletin dealing with the production of castings by the shell mold process. The bulletin describes this foundry technique and gives a pictorial illustration of how a typical shell mold casting is made. It also contains pictures of various castings made by this method and comparative case histories of castings made by shell molding and by green sand molding. The bulletin, No. 100 K12, is available upon request from Builders Iron Foundry, Inc., 345 Harris Ave., Providence, R. I.

Pulsating Bin Panels

The use of pulsating panels in preventing the clogging of bins and hoppers is discussed in "When Bulk Materials Hang Up," by E. A. Davis, a reprint of an article in *Modern Materials Handling*, September, 1952. The reprint is offered by Gerotor May Corp., Baltimore 3, Md.

The panels and their operation are described, and several case histories are related. The applications in which the panels are said to be especially valuable and the limitations of the panels are given. Copies are available on request from Gerotor May.

Testing Instruments

A buyer's guide on electric testing instruments has been announced as available from the General Electric Co., Schenectady 5, N. Y.

The 16-page bulletin, designated GEA-5469B, provides data on such instruments as hook-on volt-ammeters, hook-on watt-meters, hook-on power-factor meters, portable recorders, voltmeters and ammeters, phase-sequence indicators, hand pyrometers, surface roughness scales, and insulation-resistance meters.

Application data, features of each instrument, and prices are included.

Nickel Alloy Publications

The International Nickel Co., 67 Wall St., New York 5, N. Y., is offering three catalogs of their publications to engineers interested.

List A, 16 pages, covers publications relating to nickel alloy steels, stainless steels, nickel cast irons, nickel brasses and bronzes, and nickel plating. List B, 12 pages, has available literature on Monel, R Monel, K Monel, KR Monel, S Monel, nickel, Duranickel, low-carbon nickel, Inconel, Inconel X, and Incoloy. List D, four pages, gives available publications on ductile iron.

Each list carries brief abstracts of each publication, together with its source if it is a reprint.

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DOW CORNING

Silicone News

No. 4 of a Series • PUBLISHED BY DOW CORNING CORPORATION, MIDLAND, MICHIGAN

Typical Damping Applications For Silicone Fluid Simplify Design, Improve Performance

In designing the new Time-Master dictating machine, engineers at Dictaphone Corporation developed an ingenious device for damping the drop of the recording head onto the plastic Dictabelt recording medium. This device protects the diamond point on the recording stylus; prevents sharp indentation of the belt at the point of first contact; helps the recording head to ride smoothly over a slightly creased or damaged belt.

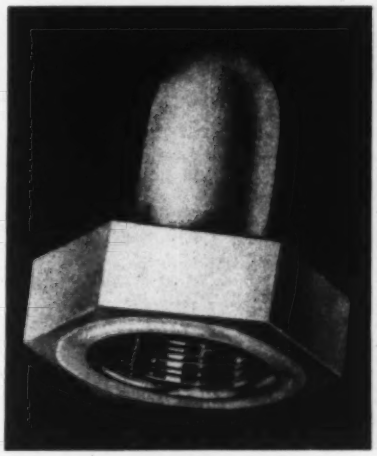
Dow Corning 200 Fluid was selected as the damping medium because its remarkably flat viscosity-temperature slope assures a constant damping force over the entire range of climatic temperatures. High resistance to oxidation and gumming assures long, trouble-free service.

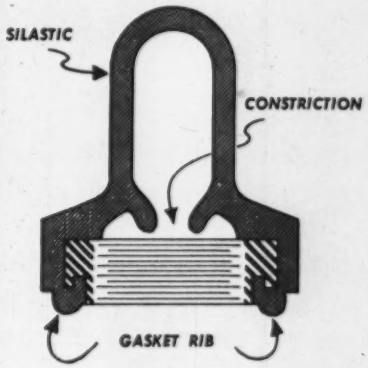
And availability in a wide range of carefully controlled viscosities reduces manufacturing costs. Liberal tolerances on the mating cylinders are compensated for by the simple selection of the fluid viscosity required to maintain an optimum damping force.

Furthermore, cost of the silicone fluid is almost negligible because the stability of Dow Corning 200 Fluid is so great that Dictaphone's engineers were able to design an effective damping device so small that the fluid is injected with a hypodermic needle.

Another recent application for Dow Corning 200 Fluid as a damping medium is in an automatic, electronic check-weight scale. Designed to weigh up to 120 packages a minute, the speed and accuracy of the scale is maintained by using a silicone fluid in the dashpot.

Organic fluids originally used as damping media thickened on cold mornings and reduced weighing speed. They thinned out in hot weather or after operating in the heat generated by the electronic components, and reduced the accuracy of the scale. These problems inherent in any fluid damping device where consistent performance is important were eliminated by using Dow Corning 200 Fluid. *No. 32*





Silastic* Boots Seal Toggle Switches at −80 to 500 F; Have 50 Times MIL Specification Flex Life at −67 F

You can seal a low temperature toggle switch by clamping a small Silastic O-ring between the metal parts. But that involves a multiple part assembly and does not provide insulation in case of short circuits.

That's why there has been so much interest in the Hexseal No. 1030, a new design developed by the Automatic & Precision Manufacturing Company of Yonkers, New York. In this unit the entire toggle is enclosed in a Silastic boot that is molded to the fastening nut.

Chemically bonded to a nickel-plated brass nut and serving both as a seal and locknut, the one-piece Hexseal can be easily and rapidly fastened down by hand. An integral rib at the base acts as a gasket when the Hexseal is secured, seating firmly against any panel surface, regardless of finish.

To determine flex resistance, the boot was subjected to 50,000 cycles at −67 F, or over 50 times the Military Specification (MIL-B-5423), without failing. It also withstood 100,000 cycles at room temperature; or 10 times the specification for the switch itself.

To make a good product even better, an inner constriction is molded in the throat of the boot. Should the tip become damaged, dirt and moisture are still excluded and pressure is still maintained. One potential user tested this feature by cutting off the tips. After thorough testing, they awarded contractual approval of the boots.

These Silastic toggle switch boots are already spreading from military to industrial applications. Originally specified for walkie-talkies, reflector buoys and bomb sights, they are now being used on industrial autoclaves and domestic butter churns.

In addition to the excellent low temperature flexibility demonstrated in the Hexseal application, Silastic 50 also gives excellent service in high temperature applications. Its dielectric properties make it a practical wire covering and cable coating for many electrical applications. With the exception of compression set, Silastic 50 meets all the requirements of SAE-ASTM Specification TA 505. It is a good, all purpose stock for making molded parts, tubing, gaskets, seals and belts that must remain serviceable over a wide range of temperatures.

Flex life of Silastic 50 at high temperatures is indicated in Table I. Failure to take a 180° bend over a ⅜ inch mandrel without breaking was taken as the end point in these flex life tests. At temperatures which caused organic rubber to fail in 8 to 96 hours, Silastic withstood 1344 to 6384 hours of exposure without failing the flex tests.

Using hardness as another measure of flexibility, samples of Silastic 50 kept

* T. M. REG. U. S. PAT. OFF.

(continued pg. 2)

FOR DATA RELATING TO THESE ARTICLES, CIRCLE REFERENCE NUMBER IN COUPON ON NEXT PAGE

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MORE

DOW CORNING Silicone News

NEW DEVELOPMENT AND TECHNICAL DATA

For copies of any of the publications reviewed in this column or for data relating to any of the articles printed in this issue of the Dow Corning Silicone News, simply circle the corresponding reference number on the coupon below.

"Silicone Release Agents for the Plastics Industry" describes various silicone mold lubricants, methods of application and concentrations used in compression, transfer or injection molding and in extruding, sheeting, rolling or forming of plastic parts. *No. 33*

•

The "Properties of Dow Corning Electrical Insulating Varnishes and Resins" are now compiled in a handy reference sheet. Typical applications and data on dielectric properties, viscosities, thinners and drying times simplify the preliminary selection of resins and varnishes for specific applications in the electrical industry. *No. 34*

•

"Silicone Finishes for High Temperature Applications". This reprint of an article that appeared in FINISH magazine describes the properties and applications of various types of silicone resins used in formulating heat resistant paints with 10 to 50 times the life of the best organic finishes. *No. 35*

•

Silicone-based water repellent finishes for above grade masonry walls repel water and water borne stains; virtually eliminate efflorescence and spalling without plugging the pores or changing the color or texture of masonry surfaces. Easy and inexpensive to apply, such silicone treatments remain effective for many years. Over 60 formulators of masonry water repellents made with Dow Corning silicones, are listed in our current "Sources of Supply". *No. 36*

•

"Silicones in Plant Auxiliaries" is the title of a significant article that appeared in the November 15th issue of ELECTRICAL WORLD. It tells how Consolidated Edison is using silicone (Class H) insulation to increase the life and reliability of motors and transformers. Solid proof of the performance of silicone insulation are orders placed since 1945 for over 106,000 hp in Class H motors rated from 200 to 2300 hp for station auxiliary power drives. *No. 37*

•

"Shoe Saver" is a new Dow Corning silicone product recently introduced for industrial use through Safety Supply Houses. Easy to apply and economical to use, it keeps leather shoes, gloves and oil guards soft and flexible, preserves stitching, increases resistance to abrasion and heat. "Shoe Saver" lets air in; keeps water, oil and various chemicals from penetrating the leather. AVAILABLE TO INDUSTRY THROUGH SAFETY SUPPLY HOUSES. *No. 38*

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New Silicone Resin Speeds Production of Laminates with 20,000 psi Flex Strength after 200 Hours at 500 F

Silicone-glass panel boards, tubes and structural parts with flexural strengths in the range of 50,000 psi at room temperature, and 12,000 to 20,000 psi at 500 F can now be laminated at low pressures and cured in a relatively short time at 480 F or cured in service.

Such laminates made with Dow Corning 2106 retain high physical strength even after aging at high temperatures. They are also water repellent, resistant to oxidation and to attack by many inorganic reagents. Inorganic laminates bonded with Dow Corning 2106 meet the requirements of Class H insulation.

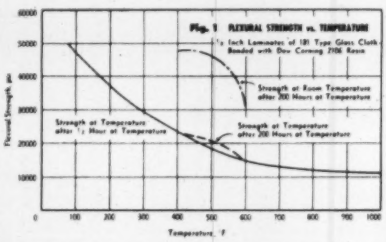
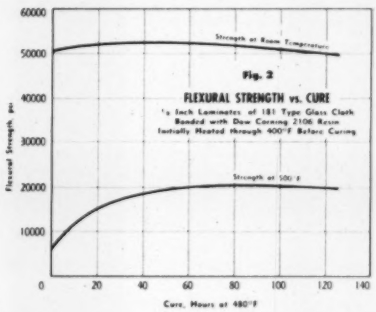


Fig. 1 FLEXURAL STRENGTH vs. TEMPERATURE
Strength at Temperature after ½ Hour at Temperature
Strength at Room Temperature after 200 Hours at Temperature
Strength at Temperature after 200 Hours at Temperature
Temperature, F

Typical ⅛ inch laminates of 181 type glass cloth bonded with 2106 and cured for 48 hours at 500 F, have an initial flexural strength of 50,000 psi. As shown in Figure 1, flexural strength measured at room temperature is in the range of 40,000 to 50,000 psi after 200 hours of aging at temperatures up to 500 F. Flexural strengths measured at 100 to 1000 F after conditioning for ½ hour at the test temperature gradually decrease from 50,000 to 11,000 psi with increasing temperature. At temperatures from 100 to 500 F and after aging for 200 hours at test temperature, flexural strength is more than 20,000 psi.



Even before curing, such laminates have a flexural strength of 50,000 psi at room temperature, as shown in Figure 2. Flexural strengths at 500 F are: 12,000 to 15,000 psi after curing 6-12 hours at 480 F; 14,000 to 18,000 psi after curing 24 hours; 18,000 to 20,000 psi after 48 hours at 480 F. These data indicate that laminates made with Dow Corning 2106 may be cured in service. *No. 39*

SILASTIC *continued*

TABLE I RESISTANCE TO HEAT AGING

Temp	Hours	Flex Life		Durometer, Shore A	
		Silastic	Organic	Silastic	Organic
300 F	0	OK	OK	54	61
	96	OK	Failed	57	
	168	OK		59	
	1344	OK		64	
	6384	OK		65	
392 F	0	OK	OK	54	61
	19	OK	Failed	54	
	168	OK		55	
	1344	OK		62	
	6384	OK		68	
480 F	0	OK	OK	54	61
	8	OK	Failed	54	
	168	OK		60	
	1344	OK		70	

their initial room temperature hardness of 56 at temperatures up to 480 F; increased to 60 at —67 F for a total change of only 4 points over a span of 547 Fahrenheit degrees.

After 70 hours immersion in water at 212 F, Silastic 50 showed only 4% increase in volume, 4 points decrease in hardness, no change in elongation, and 11% loss in tensile strength.

Silastic 50 can be blended with Silastic 80 to make parts with any hardness between 50 and 80. It can be given almost any color by adding heat-stable pigments. *No. 40*

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Silicone Molding Compounds
Silicone Expansible Resins
Silicone Defoamers
Silastic

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Chains and Sprocket Wheels

Beaumont Birch Co. has published Bulletin 11-53-C, a four-page leaflet on Beaumont Dura-Tred Combination Chains and Trac-Pull Wheels. Dura-Tred Combination Chain advantages are emphasized, and sizes and dimensions are listed. The Trac-Pull Wheel, designed for Dura-Tred chains, is made with a corrugated rim, unlike conventional sprocket wheels.

The bulletin is available on request from Beaumont Birch Co., 1505 Race St., Philadelphia 2, Pa.

Fluid Power Equipment

Bulletin 10051-C, 12 pages, illustrates and describes Oilgear's line of fluid power pumps, motors, transmissions, cylinders, and valves. It features an expanded line of variable- and constant-delivery pumps for operation at higher speeds, a new line of small (1-hp) variable-delivery pumps, a new line of constant-delivery duplex pumps for pressures up to 5000 psi, and a larger-capacity feed pump. Requests should be sent to the Oilgear Co., 1570A West Pierce St., Milwaukee 4, Wis.

Self-Aligning Swivel Joints

"Self-Aligning Swivel Joints for Piping" is the title of a 12-page bulletin which has been published by Barco Mfg. Co., maker of flexible ball, swing, swivel, revolving, and other types of movable joints for use in piping for power, process, heating, chemical, or hydraulic service.

Barco manufactures 14 styles of the joint and eight different sizes, from $\frac{1}{4}$ in. to 2 in., and offers a choice of four different service specifications for handling temperatures from −50 to 600 F, pressures from vacuum to as high as 600 psi steam, or 3000 psi hydraulic. Copies of "Self-Aligning Swivel Joints for Piping" may be obtained by addressing requests to Barco Mfg. Co., Dept. J-31, 501 Hough St., Barrington, Ill., for Catalog No. 265-A.

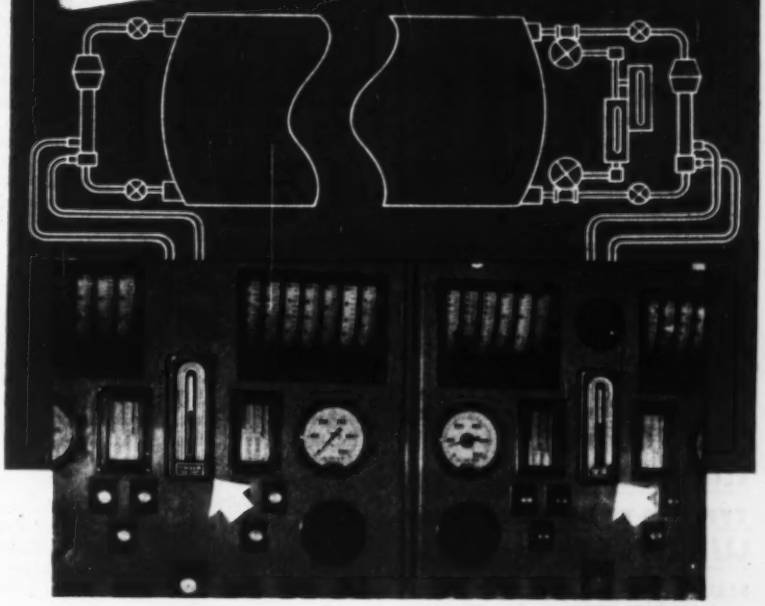
Expansion Bellows

A six-page Bulletin No. 300, issued by Titeflex, Inc., Newark, N. J., describes this company's special type of metal expansion bellows for conveying gas and liquids. Text and diagrams explain the welded-diaphragm construction of the bellows.

Two modifications of this welded bellows construction are described: a standard ("male") type and a "nesting" type. The standard "male" type of this bellows is available in a total of 50 standard sizes, from 1.0-in. to 5.0-in. ID; and the nesting type is available in 27 standard sizes, ranging from 0.687-in. to 7.375-in. ID.

Bellows of special sizes, with special flanges and fittings, are made up on order to meet special application requirements. In both regular or special production the bellows are available in a variety of metals to meet special requirements. A specification sheet listing engineering information required for ordering is also included.

Latest boiler code provision permits new water gage facility on high pressure boilers



Now two EYE-HYE Remote Gages give you the required double check on pressures 900 lbs and over

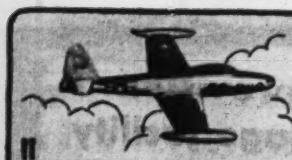
Two independent remote level indicators of the compensated manometric type may now be used instead of one of two gage glasses required on pressures 900 psi and over. You still must have one conventional type gage, maintained in serviceable condition, but it may be shut off while both remote indicators are in operation.

This is a tremendous advantage. It removes the need for checking high gages, maintaining mirrors or other water level reading methods. EYE-HYE's sharp, illuminated indication is frequently reported as more accurate than gages at the drum. Now the two gages required can be at eye height—convenient, safe—a true double check on the vital boiler water level.

For full details of the new code interpretation read Case No. 1155. For information about Reliance EYE-HYE, call your Reliance representative or write for Bulletin CO.

The Reliance Gauge Column Co. 5902 Carnegie Ave., Cleveland 3, Ohio

Reliance EYE-HYE
Remote Reading Gage
All-hydrostatic • Reads like a tubular glass gage



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"Under actual tests, LUBRIPLATE extended bearing life fifty per cent or better as compared to other lubricants. It was also found that, during test, LUBRIPLATE increased efficiency of machines twenty per cent by reducing friction loss. Republic has been using LUBRIPLATE successfully for the past eight years."

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LUBRIPLATE is available in grease and fluid densities for every purpose... LUBRIPLATE H.D.S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

Rubber Products

A four-page, two-color, illustrated brochure in file-folder form, outlining its facilities for producing quality rubber products through engineered compounds, has been published by Goshen Rubber Co., Goshen, Ind. The publication explains that Goshen Rubber is a producer of O-rings for hydraulic and pneumatic design applications, made to MIL and commercial specifications from proven synthetic and silicone rubber compounds. Goshen Rubber's facilities for formulation and manufacture of molded, lathe-cut, die-cut and bonded-to-metal products from natural, synthetic, and silicone rubber compounds are explained.

Electric Power Drives

Sterling Electric Motors, Inc., has issued Bulletins 181 and 182 on its line of electric power drives.

Bulletin 181 covers Sterling's Klosd and Klosd-Tite models, illustrating the advantages of these constant normal speed motors, totally enclosed fan-cooled and totally enclosed non-ventilated types, or splashproof or dripproof. A general description of the motors is included.

Bulletin 182 covers both Speed-Trol and Slo-Speed variable speed motors and Klosd and Klosd-Tite constant-speed motors. Specifications are listed.

Copies of the bulletins are available from Sterling Electric Motors, Inc., New York 51, N. Y.

Designing for Glass-Bonded Mica

An illustrated "how-to-do-it" booklet on designing parts to be machined from Mycalex glass-bonded mica has been issued by Mycalex Corp. of America, Clifton, N. J. The 24-page publication, "From One Designer to Another," contains tables, specifications, charts, and workbench sketches. An index is included.

The booklet is divided into eight major chapters. Discussed in detail are such points as general considerations (including a section on when to break the rules), sizes and shapes, inserts, tolerances, holes, threads, contours and profiles, and grades.

"From One Designer to Another" is the second instruction-reference manual issued by Mycalex Corp. The first, "From One Machinist to Another," made available recently, discusses machining of Mycalex glass-bonded mica. Copies are available on request.

Rust Preventives

The Rust-Oleum Corp., manufacturer of rust preventives, 2799 Oakton St., Evanston, Ill., has released their 1954 General Catalog on rust prevention and preventives.

The catalog features 94 color chips of Rust-Oleum products and includes instructions for surface preparation and application of Rust-Oleum primers, short oil type, long oil type, machinery and implement finishes, chemical and heat-resistant types, sealers, oil field finishes, thinning oils, and floor and masonry coatings.

Among the new products described in the 1954 General Catalog are the Restful Color Group of finishes developed to provide new color harmonies for plant interiors and machinery surfaces; Rust-Oleum Oil Field Finishes, especially prepared to match original manufacturers' colors and resist extreme rust-producing conditions of the oil fields; and the Rust-Oleum lamb's wool roller for painting wire fences. Application photos are used throughout the book to show how each type of Rust-Oleum product is used.

In addition, two pages of the catalog are devoted to questions and answers. A copy is free on request for Form No. 253.

Dial Thermometers

A 16-page bulletin, describing dial thermometers for long distance measurement, has been issued by The Foxboro Co. of Foxboro, Mass. Emphasizing the variety of ranges, and the bulbs, tubing, and accessories available, the bulletin provides data on temperature indicators of the vapor pressure and gas pressure types.

A separate section gives details of construction. Discussed in detail is the ball and trough movement which, by eliminating connecting links, avoids loss of motion either up or down the temperature scale.

Both centigrade and Fahrenheit ranges are listed for Class II and III systems (vapor pressure and gas pressure). Fahrenheit ranges cover all frequently-used scales from −300 to 600 in Class II and from −250 to plus 1000 in Class III. The method of determining which class of system to use for a given application is explained.

Six pages are devoted to bulbs, tubing, and accessories. Dimensions and bulb lengths are given for plain and union type bulbs, with bendable and rigid necks. Five types of connecting tubing are illustrated and bushings, sockets, and flanges are described. Diagrams show suggested installation methods, covering cookers, retorts, kettles, and pipelines. Copies of the bulletin, 467, will be sent on request.

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Drafting Instruments and Methods

The new catalog of the John R. Cassell Co., Inc., 110 West 42nd St., New York 18, N. Y. features an explanation of "Three-Dimensional Drafting," usually termed axonometric drawing.

The rest of the catalog contains illustrations and descriptions of Cassell's Instrumaster instruments used in axonometric drawing, including templates and stencils.

Optical Projection Comparator

An eight-page descriptive bulletin on the AO Optical Projection Comparator Model 2002 is offered by the Optical Gaging Products, Inc., national distributors, 26 Forbes St., Rochester 11, N. Y.

A full-color full-page photograph of the comparator serves as frontispiece, followed by a list of the advantages offered and a description of the requirements of measuring accuracy in an optical projection comparator. The elements of the comparator are discussed: optical projection system, illumination, screen, mirror, work stage, focussing, base, and the cast aluminum construction. A page of specifications completes the bulletin.

A-C Motor Frame Selection Chart

A selection wall-chart which shows the comparison between "old" and "new" NEMA standard dimensions for a-c motors from 1 to 30 hp is available from the Westinghouse Electric Corp. The chart is meant to provide a reference for determining differences in frame dimensions.

New and old dimensions for polyphase squirrel-cage, polyphase wound-rotor, and single-phase, foot-mounted motors are presented as well as separate dimensions for flange-mounted motors. Dimensions for drip-proof and totally enclosed, fan-cooled motors are also given.

The chart, which measures 18 by 24 in., gives old dimensions in blue, new dimensions in red, one immediately above the other, so that differences can be detected at a glance. The chart, will be sent on request by Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa.

Copper-Base Alloys

"The Ni-Vee Bronzes (Parts 1 & 2)" is the title of Bulletin A 107-8, 12 pages, with 35 tables, charts, and illustrations. The booklet presents a family of low-shrinkage, heat-treatable bronzes for machine component pressure and bearing castings, that develop excellent mechanical properties in the "as cast" condition.

A relatively simple heat treatment is described that is said to increase as-cast strengths 30 to 60 per cent, culminating in the 90,000-psi range. They are shown to be economical, fine grained, pressure tight, and versatile. Typical compositions and applications are given. Copies are available from the International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

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THAT STAVES
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LIKE human skin, which takes on a tan from the sun's rays, Kentanium protects itself from destruction by forming a thin oxide surface coating when exposed to extreme heat. This characteristic—combined with Kentanium's great strength, high hardness (up to 93RA), and thermal shock resistance—greatly extends the possibilities of high temperature design.

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If you need a material for long life under high temperatures, investigate Kentanium. An exclusive development by Kennametal—it is a titanium carbide base composition. It weighs only ⅗ as much as steel.

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Specialized Industrial Equipment

L. O. Koven & Brother, Inc. has released Bulletin No. 550, "Specialized Equipment Designed and Built by Koven," describing and illustrating 31 pieces of equipment, including mixers, kettles, vacuum and pressure vessels, autoclaves, evaporators, impregnators, condensers, stills, extractors, tanks, standpipes, piping, and stacks.

Electrical Resistance Tester

James G. Biddle Co. has issued Bulletin 21-85-51 on its Megger Electrical Resistance Testers. Models included are the Midget Megger Insulation Tester, with ratings up to 50 megohms, 500-v direct current; the CVM Megger Insulation Tester, a constant-voltage type, with ranges up to 0–50 megohms or 0–10,000 ohms at 500 v; and the Midget Megger Circuit-Testing Ohmmeter, battery-operated, available in ranges from 0–1 and 0–10 to 0–1000 and 100–200,000 ohms. Facsimile scales are shown for each model, together with specifications, description, and applications.

Bulletin 21-755 describes the Midget Megger Insulation Tester with a carrying case which permits the instrument to be used without removing it from the case.

Requests for either bulletin should be sent to James G. Biddle Co., 1316 Arch St., Philadelphia 7, Pa.

Pop Safety and Relief Valves

An illustrated 12-page circular, describing its complete line of pop safety and relief valves for steam, air, gas, water, oil, and other liquids, has been published by The Lunkenheimer Co. of Cincinnati, Ohio.

Complete with leading dimensions this circular contains information in the form of steam, air, and gas relieving capacity tables; a table of multipliers for computing relieving capacities at various inlet temperatures; and another table of multipliers to permit computing relieving capacities for air valves for use in handling gases and vapors.

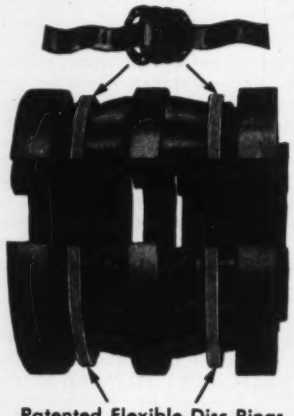
Designed in conformance with ASME, American Petroleum Institute, and Bureau of Marine Inspection and Navigation Codes, Lunkenheimer Pop Safety Valves are available in all-bronze or iron body, bronze mounted styles. They are equipped with either top or side outlets to facilitate installation and with pressure settings ranging from 1 to 400 psi. Higher settings are available on special order.

Lunkenheimer Relief Valves, designed for use with water, oil, and other liquids, are furnished with either cap over the regulating screw, or the exclusive Non-Slip Handwheel. They are regularly available with pressure settings ranging from 1 to 250 psi in either bronze or iron body, bronze mounted styles. Relief valves are also available in higher settings on special order.

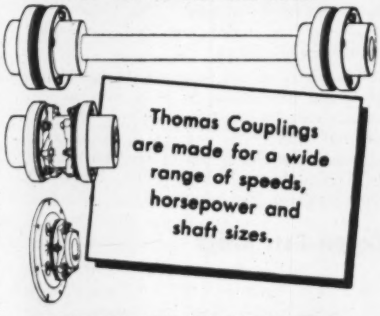
Copies of this Circular 502 may be obtained by writing to The Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

Specify **THOMAS** ALL METAL **FLEXIBLE COUPLINGS**
for Power Transmission to avoid Costly Shut-Downs

DISTINCTIVE ADVANTAGES	
FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.



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WARREN, PENNSYLVANIA, U.S.A.

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Power Transmission Equipment

An eight-page booklet on Lovejoy power transmission products has been published by the Lovejoy Flexible Coupling Co.

Flexible couplings, variable-speed pulleys and transmissions, and universal joints are covered. Dimensions and other specifications are given in tables for each model type and size.

Photographs and diagrams complete the bulletin, which is available on request from the Lovejoy Flexible Coupling Co., 4965 West Lake St., Chicago 44, Ill.

Fasteners

An illustrated 24-page handbook describing fastening specialties has been issued by Southco Div., South Chester Corp. A section is devoted to each of seven different fastener types: screw fasteners, blind rivets, adjustable pawl fasteners, door latches, spring-grip fasteners, anchor nuts, and door retaining springs. Each section has photographs, drawings, tables of dimensions and size, and descriptions.

Copies of the Southco Catalog B2 may be obtained free of charge by writing to Southco Div., South Chester Corp., 1400 Finance Bldg., Philadelphia 2, Pa.

Hydraulic Pumps and Motors

The Gerotor May Corp. is distributing Catalog Sections G-101, G-103, G-106, and G-110, reprinted from its catalog, as four-page bulletins on several of its hydraulic pumps and motors.

G-101 covers Gerotor Type B Hydraulic Pumps, which provide up to 1.42 gpm at 1000 psi discharge pressure or 1.67 gpm at 0 psi discharge pressure, at a speed of 1800 rpm. Type O Hydraulic Pumps are described in G-103. At 1200 rpm Type O pumps will provide up to 40.0 gpm at 1000 psi discharge pressure or 43.0 gpm at 0 psi discharge pressure.

G-106 shows Type QH Hydraulic Pumps, which at 1200 rpm deliver up to 11.7 gpm at 1200 psi discharge pressure or 12.9 gpm at 0 psi discharge pressure. The fourth bulletin, G-110, includes Series B, O, and QH Hydraulic Pumps, and Series ME and MH Hydraulic Motors.

In each bulletin the Gerotor principle of construction and operation is illustrated and explained, and selection data and other specifications are given for each model. Copies are available, together with additional information, from Gerotor May Corp., Baltimore 3, Md.

Magnetic Chucks

The Taft-Peirce Mfg. Co. has published Catalog No. 411 on its entire line of electromagnetic chucks. The advantages of magnetic chucking are discussed in the catalog, which also contains a section of recommendations on their use. Typical applications are illustrated, and the remainder of the 16-page booklet contains photographs of the different models of chucks, tables of specifications, and descriptions of accessories.

Catalog No. 411 is obtainable on request from the Taft-Peirce Mfg. Co., Woonsocket, R. I.

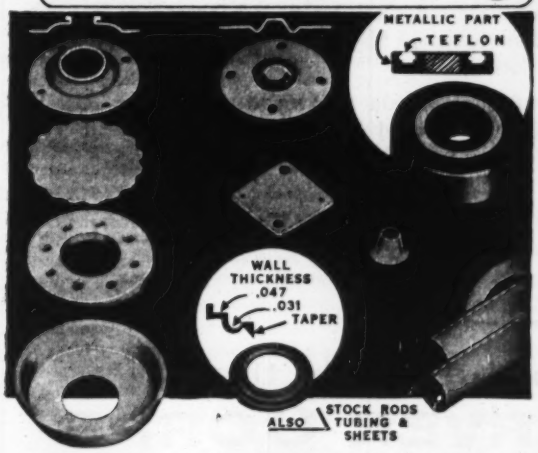
Automatic Garages

Materials handling methods in the solution of off-street parking problems are discussed in "Auto Parking—Problem, Cost, Solution" by Charles W. Lerch, Charles W. Lerch & Associates, 1172 Board of Trade Bldg., Chicago 4, Ill. The operation of the different types of ramp, semi-automatic, and automatic garages is covered, and their costs compared.

The author's recommendation for heavy-traffic and high-land-cost areas is an automatic operatorless garage, using elevators and vertical parking. The booklet may be obtained from Charles W. Lerch & Associates.

GOT A TOUGH ONE IN TEFLON?

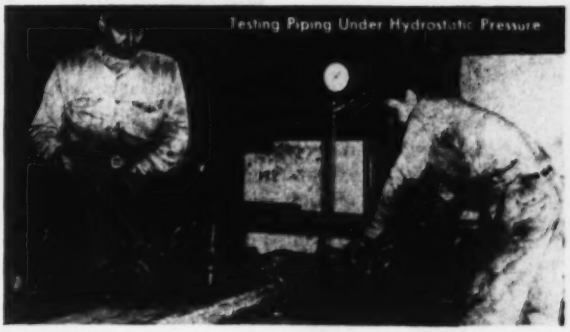
CONTACT SPARTA, SPECIALISTS IN TEFLON MOLDING



Above, some recent Teflon moldings by Sparta. Represented are Diaphragms, Special Washers, Discs, Seals and Cup Seals with difficult undercuts, varying wall thicknesses, other physicals formerly thought impossible to mold in Teflon.

Perhaps YOU can improve products, processes and profits with Teflon MOLDED TO YOUR SPECIFICATIONS. Sparta offers painstaking cooperation, no obligation . . . just write or call

SPARTA HEAT TREAT CO. PLASTICS DIVISION, EAST SPARTA, OHIO PHONE EAST SPARTA 5651 (CANTON, OHIO EXCHANGE)



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At Western Piping Supply every pre-fabricated piping assembly undergoes specialized shop testing before shipment.

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That's why WPS customers are always assured trouble-free piping performance in the field.

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HERE'S WHY: The potential of modern military offense is such that a surprise raid against this country could cause tremendous casualties.

Our military defense is aware of this possibility. Air Force interceptor planes and Army anti-aircraft batteries are designed to repel such an attack.

But—if that attack ever comes—*warning must come through in time!* Citizen volunteer plane-spotters—ground observers—play a vital role in providing the necessary warning.

Already some 300,000 civilian Americans are contributing to the job of guarding our ramparts. I salute these Ground Observers for their patience, their perseverance, their patriotism.

But the job calls for twice their number to man these vital posts. Will you serve your country for two hours a week?

Dwight D. Eisenhower

PRESIDENT OF THE UNITED STATES

★

Keep your eye on the sky in the

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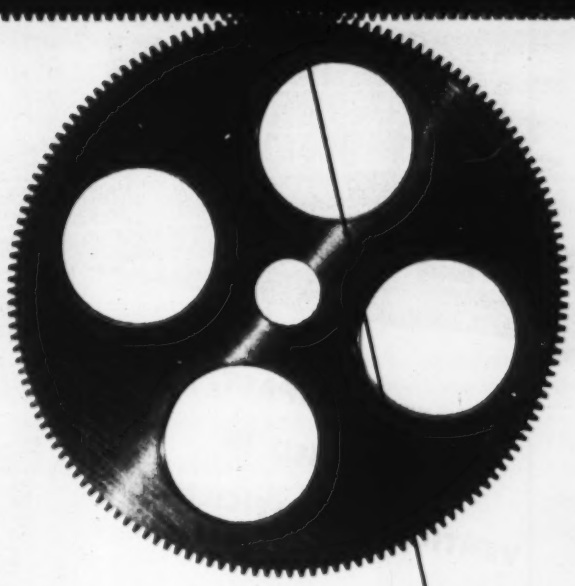
Call or write your
Civil Defense Director

Wake Up!
Sign Up!
Look Up!



Why you can *reduce rejection losses* with a Kodak Conju-Gage Gear Checker

Why the composite check

In practice, the final test of gear quality is how the gear works in use. The composite check recommended in American Standard B6.11-1951 shows this conclusively by measuring displacement of the gear when run against a master of known accuracy. And it does it in one quick operation that checks combinations of as many as six types of errors.

Why the Conju-Gage Gear Checker

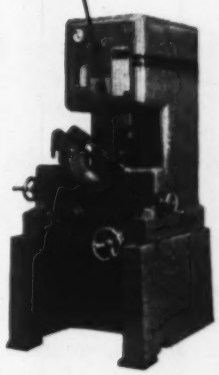
Since displacement represents the sum of both gear error and error in the master, the accuracy of the master used determines the precision of the composite check. The Kodak Conju-Gage Gear Checker uses a master of exceptional accuracy, the Conju-Gage Worm Section. Produced by thread grinding, its accuracy is not limited by the same manufacturing processes which limit accuracy in the gear itself.

To settle for masters of lesser accuracy is to rob yourself of "tenths"—to chance that tolerable error in a gear may coincide with error in the master to cause a needless rejection. Or that intolerable error in a gear may be cancelled by error in the master to pass a gear that will fail in use.

To reject every wrong gear is to guard the quality of your product. To pass every right gear is to reduce such rejection losses to a minimum.

To find out more about how a Kodak Conju-Gage Gear Checker can lower costs while maintaining required precision, send for your copy of the booklet, "Kodak Conju-Gage Gear Testing Principle." Write to

Special Products Sales Division
EASTMAN KODAK COMPANY, Rochester 4, N.Y.



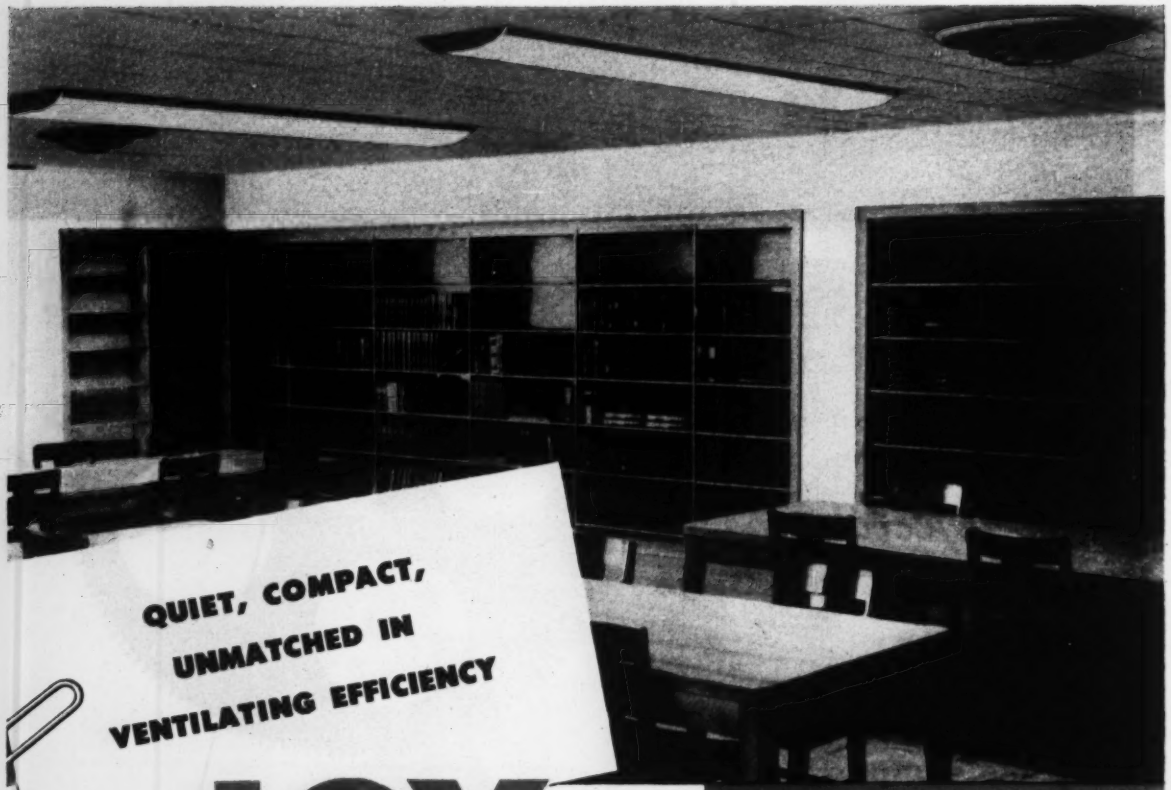
The Kodak Conju-Gage Gear Checker automatically records the composite effects of runout, base pitch error, tooth thickness variations, profile error, lead error, and lateral runout. Illustrated is the Kodak Conju-Gage Gear Checker, Model 8U, for gears up to 8¼" pitch diameter. Smaller models are also available.

CONJU-GAGE INSTRUMENTATION

... a new way to check gear precision in action

To inspect all kinds of complex parts on a bright screen, Kodak also makes two highly versatile contour projectors.

Kodak



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UNMATCHED IN
VENTILATING EFFICIENCY

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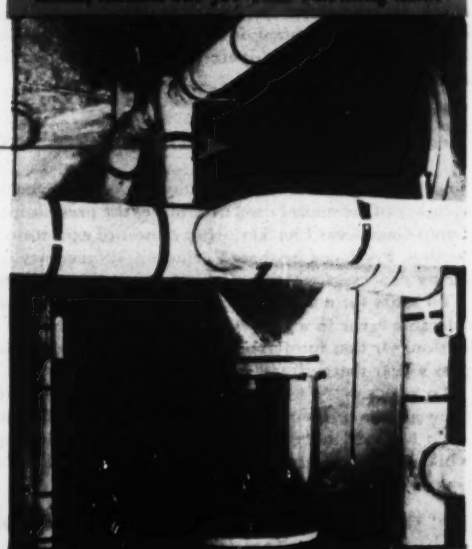
AXIVANE® FANS

...BEST in Public Buildings

The compact, vaneaxial design of JOY AXIVANE Fans offers you important advantages of quiet, more efficient operation and savings on space requirements, installation costs, and power consumption. In addition, adjustable blades—a standard JOY feature—give you easy flexibility . . . you can make a simple on-the-job adjustment to meet new or changed conditions with greatest efficiency. ● For any ventilation job, check first with JOY—world's largest manufacturer of vaneaxial fans.



Write for Bulletin, or

Consult a Joy Engineer

W&D 1 3520

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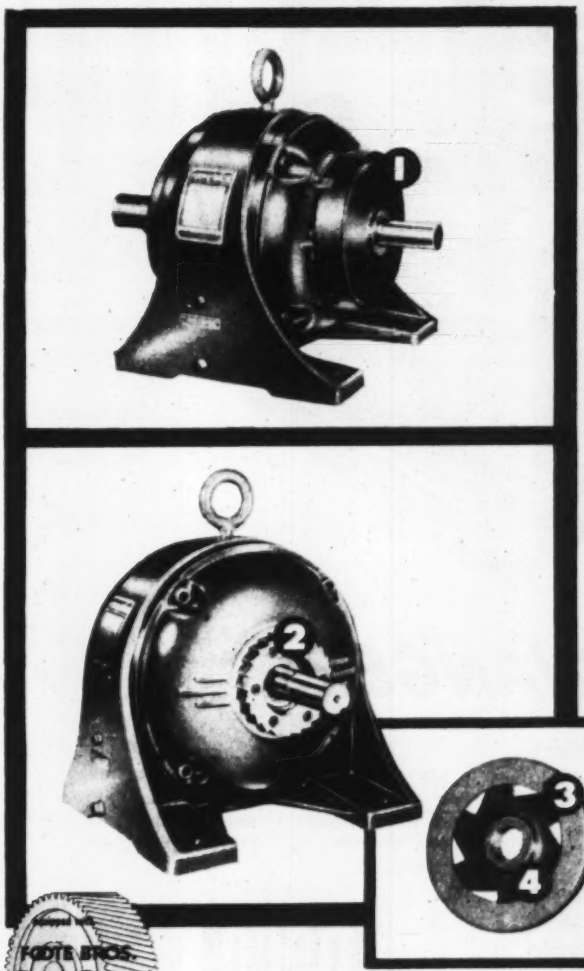
NOW ...built-in protection against reversing!

...NEW FOOTE BROS. BACKSTOP for LINE-O-POWER!



NOW . . . Positive prevention of reverse rotation! Famous straight line Line-O-Power Drives now offered with the new, built-in Foote Bros. Backstop as optional equipment!

Sturdy, compact, symmetrical — this Backstop automatically stops shaft reversal. During forward motion, operation is without contact — *noiseless and wear-free.* Because of advanced design, you can order it without regard to application or service factors . . . and you can change it in the field, in minutes, for opposite rotation. For Line-O-Powers now in service, the mechanism is quickly installed at the Foote Bros. Plant.

Here's why you get more with LINE-O-POWER Drives

Economical to buy, economical to run. Ruggedly designed for toughest jobs. Engineered around Duti-Rated Lifetime Gearing with file-hard teeth and tough, resilient cores. Higher efficiency, greater capacity and longer life — in minimum space.

In straight line design, low-cost Line-O-Power Drives are foot mounted for floor, wall or ceiling applications. Ratios range up to 238 to 1, capacities up to 178 h.p.

For right angle applications — horizontal or vertical — choose the worm-helical gear Line-O-Power, foot or flange mounted. Flange-mounted units available with standard output shaft or with an extended low-speed bearing housing for maximum over-hung load support. With ratios ranging up to 2,726 to 1, Right Angle Line-O-Power Drives are ideal for slow speed jobs.

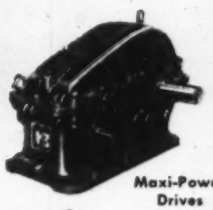
Call your Foote Bros. representative, or write for helpful information.

This Trademark Stands for the Finest in Industrial Gearing

1. **Sturdy Guard — Shields moving parts.**
2. **Machined-steel Ratchet Plate — Securely bolted to Line-O-Power housing, but easily reversed for change in direction of rotation.**
3. **Cast Backstop Housing — Rigidly keyed to input shaft.**
4. **Hardened Ratchet Pawls — Lock against ratchet plate under spring pressure to prevent counter-rotation.**

Foote Bros.-Louis Allis Gearmotors

Hygrade Drives



Maxi-Power Drives

FOOTE BROS.

Better Power Transmission Through Better Gears

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Please send me information on:

- ☐ Straight Line-O-Power Drives.
- ☐ New Foote Bros. Backstop.
- ☐ Right Angle Line-O-Power Drives.

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Company .....

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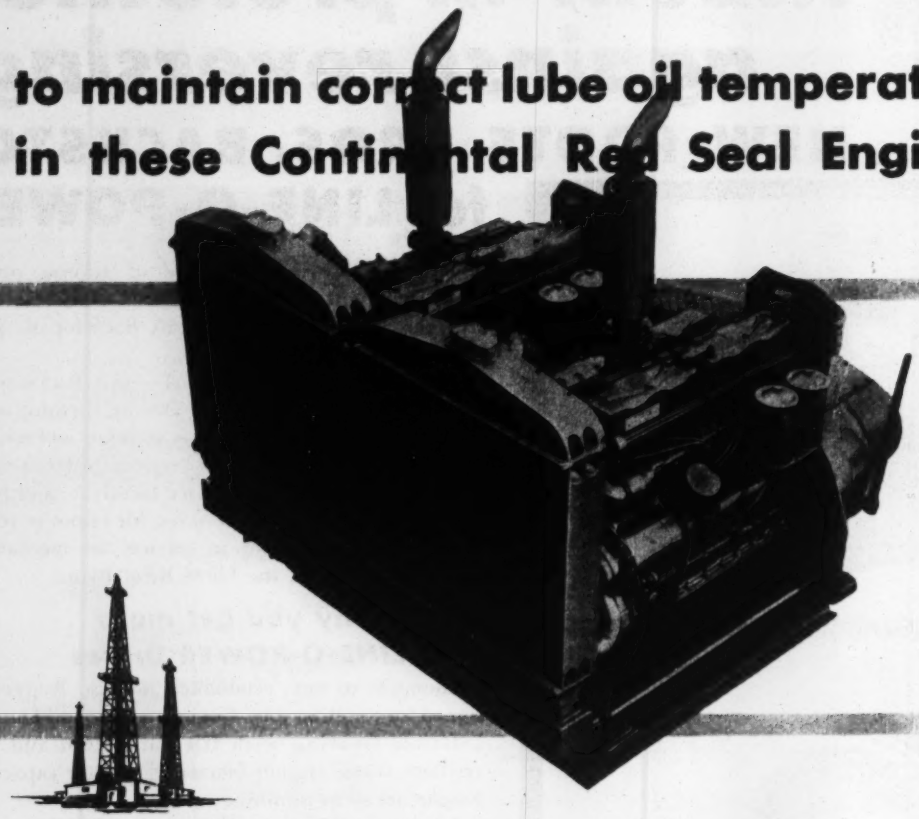
City ..... Zone ..... State .....

to maintain correct lube oil temperature in these Continental Red Seal Engines



ROSS EXCHANGERS

Furnished to power draw works or built to match the exact requirements of just about any oil field application — producing, distributing or processing — Continental Red Seal Engines are engineered "to do specific jobs supremely well".

For example: To provide close clearance parts with a free-flowing supply of properly cooled lube oil at all times, Continental Motors Corporation has equipped each of the Red Seal engines, shown above, with a Ross Type BCF Exchanger. Overheating is most dependably prevented!

Unequalled for thermal efficiency and proved ruggedness — Ross Exchangers are standard components of numerous types and makes of prime equipment . . . to cool lube oil, jacket water, torque converter fluid and hydraulic oil.

Completely pre-engineered and fully standardized, Ross Type BCF Exchangers are available with "off-the-shelf" promptness in answer to most requirements.

For complete information, request Bulletin 1.1K5.

KEWANEE-ROSS CORPORATION
DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
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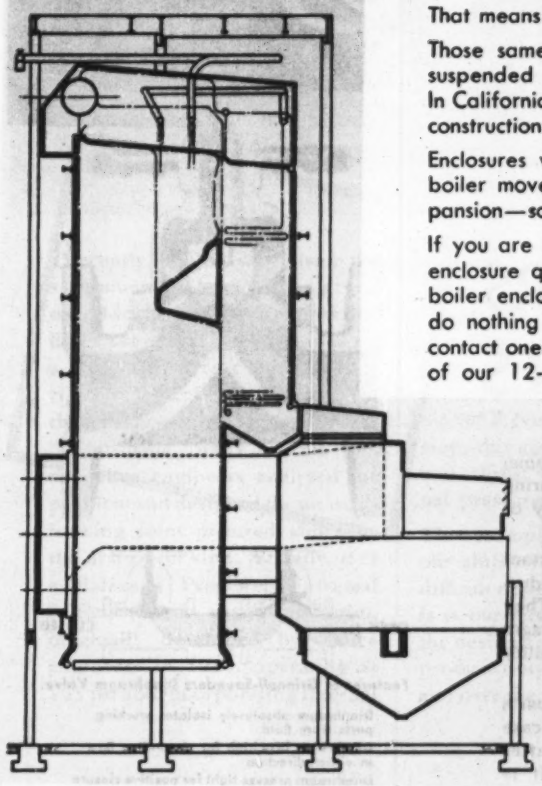
BOILERS

10 STORIES HIGH!



Three new B-I-G boilers on the West Coast will have all of the cost-saving advantages of B-L tube-supported wall enclosures and Texad* finishes. The order for one of them—a 1,250,000-pound-per-hour unit—has just been placed. Construction on the others—850,000-pound-per-hour boilers is now being started.

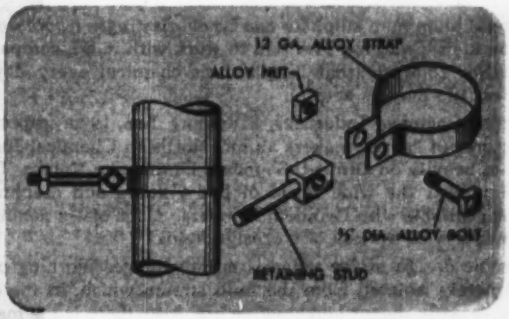
That means they'll cost less, save steel, operate more efficiently.

Those same advantages can be earned by specifying Bigelow-Liptak suspended settings for any large size industrial or public utility boiler. In California, for example, the king-sized, 10-story boilers will have lower construction and material costs and will not need tough-to-get steel plate.

Enclosures will be tighter, too. Tube-supported walls breathe with the boiler movements and TEXAD* flexes itself right along with boiler expansion—something that a steel plate casing that large could never do.

If you are building a large boiler, or a small one, insist on a separate enclosure quotation. You'll save plenty and you'll get a specially-made boiler enclosure engineered for your particular furnace by people who do nothing else but build furnace enclosures. Write Detroit today, or contact one of our conveniently-located offices. Be sure to ask for a copy of our 12-page tube-supported wall catalog—and a TEXAD* folder.

*T. M. REG.



One method B-L uses to fasten the enclosure to the tubes without welding into the tube. Tile-supporting castings are hung on the studs.

3133

BIGELOW-LIPTAK *Corporation*

and Bigelow-Liptak Export Corporation

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In Canada: Bigelow-Liptak of Canada, Ltd., *Toronto, Ontario*

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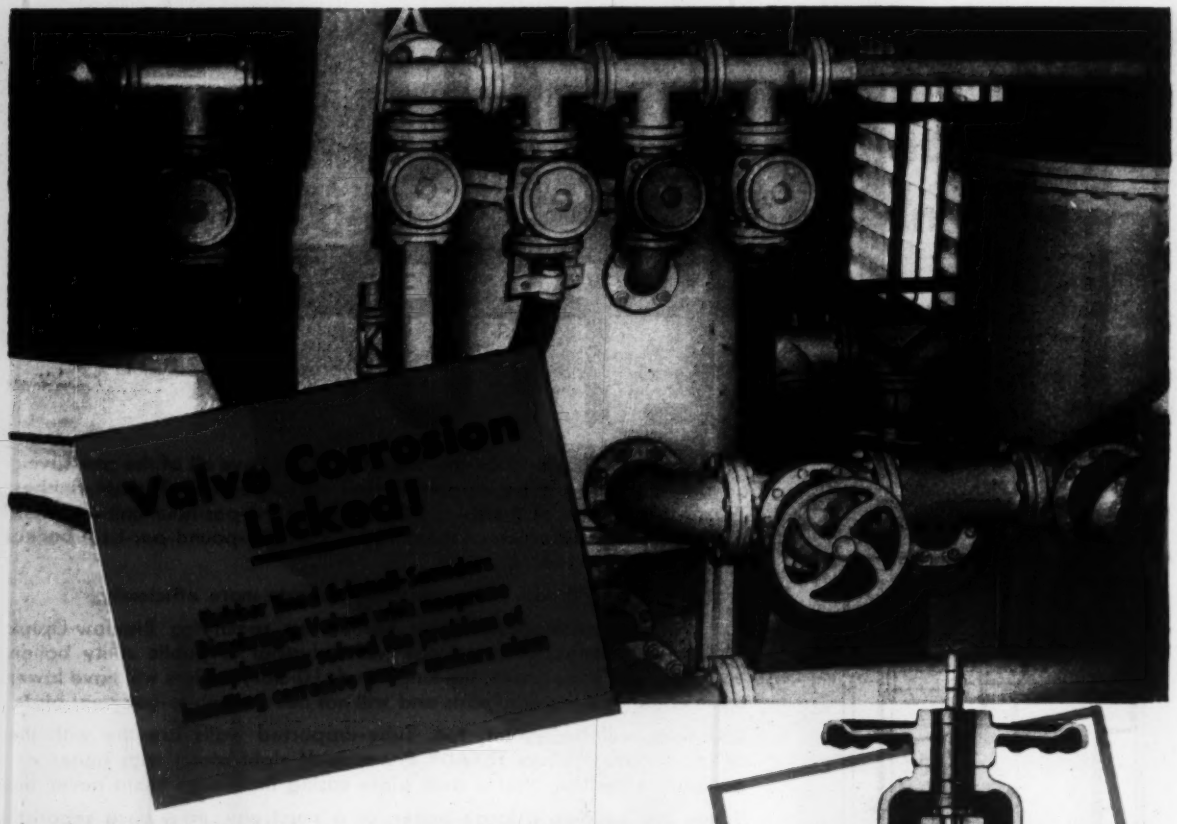
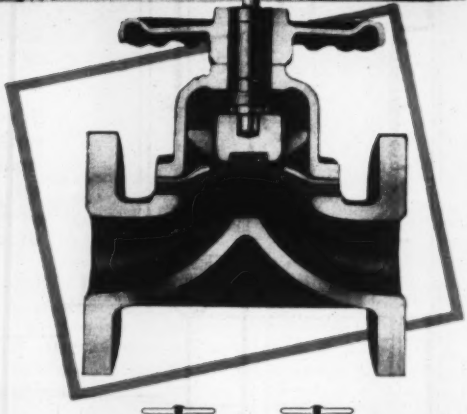
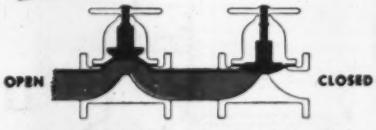


GRINNELL-SAUNDERS DIAPHRAGM VALVES





Commercial aluminum sulphate *can be everlastingly troublesome,* as anyone knows who has ever had to work with it. So, comparing notes with a company that handles this chemical every day of its business life may be helpful.

Northern Chemical Industries, Searsport, Me., is an important manufacturer of "paper makers alum". Northern Chemical Industries relies heavily on Grinnell-Saunders Diaphragm Valves. They have found that the wide range of body, lining and diaphragm materials available with Grinnell-Saunders valves offers flexibility in handling a wide variety of corrosive fluids.

The basic design of the valve is an advantage. Working parts are completely isolated from the fluid stream which, in the case of corrosive acids, means longer valve life. Also, there is the matter of economy. With Grinnell-Saunders Diaphragm Valves, it is usually possible to go to less expensive body materials, to which special body linings can be added. Replacement and maintenance expenses, moreover, are greatly reduced.

Originally designed and ideally suited for air and water service, Grinnell-Saunders Diaphragm Valves also are recommended for almost every regular or special service. This is backed up by the excellent performance records achieved by valves now in use.

Features of Grinnell-Saunders Diaphragm Valve:

- Diaphragm absolutely isolates working parts from fluid
- Diaphragm lifts high for streamline flow in either direction
- Diaphragm presses tight for positive closure
- Body, lining and diaphragm materials to suit service
- Simple maintenance — diaphragm easily replaced without removing valve from line

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WHENEVER PIPING IS INVOLVED

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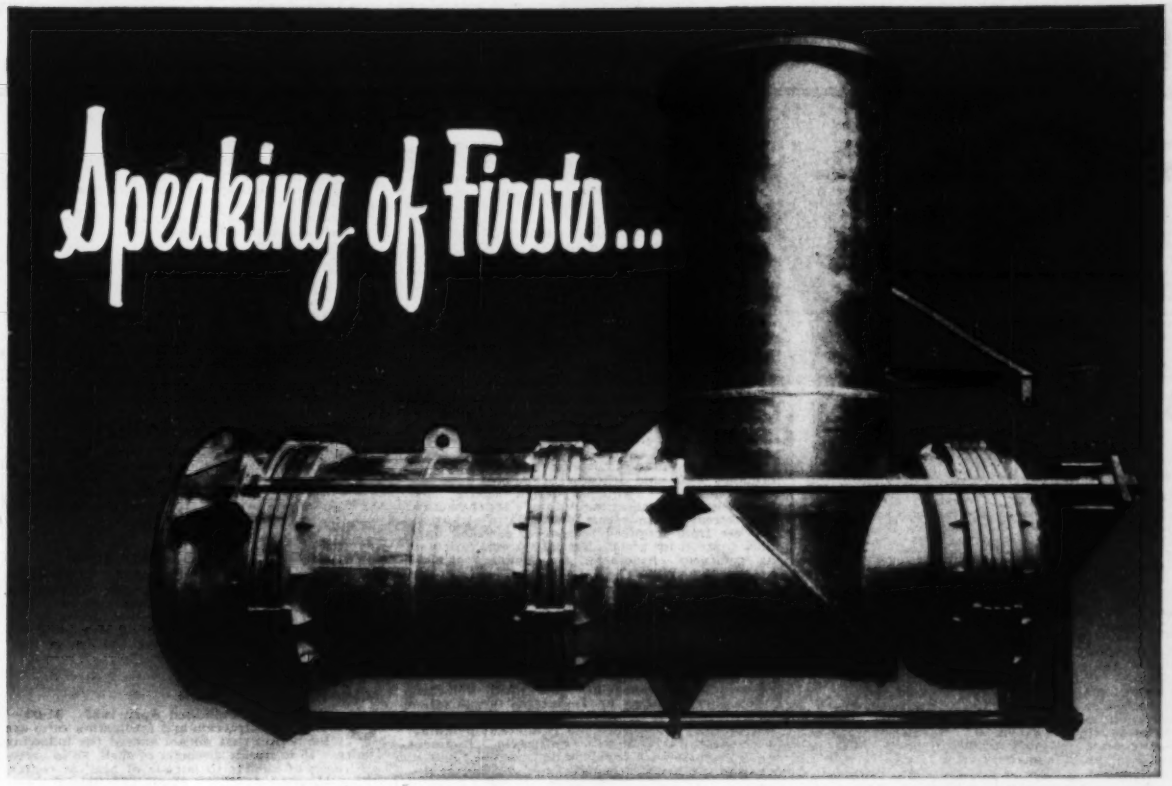


Recently, Zallea was given the assignment of developing a group of 48-inch expansion joints for flight propulsion test facilities on a classified defense project. The rigid technical specifications of this advanced application required "tailor-made" units for the job, so Zallea engineers analyzed the problem and designed the unusual-looking joint pictured above . . . the first of its kind. Actually, it is a Balanced Pressure, Universal Self-equalizing expansion joint, originally developed by Zallea engineers in 1945, operating at 165 psi and incorporating internal stainless steel turning vanes to provide a smooth flow of gases through the right angle bend. The unit absorbs 3" axial and 1.27" lateral movements through a temperature range from −100° F. to +650° F. No anchors are required since this arrangement neutralizes end thrust developed by internal pressures.

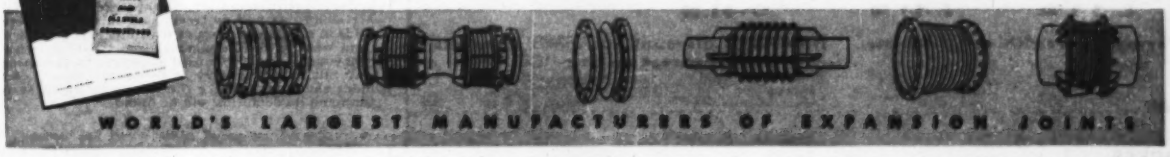
This example is representative of our ability to cope with the most difficult expansion joint problems. It is our business to specialize in the design and manufacture of one product only—expansion joints—and over the years we have learned how to solve the "tough ones" effectively and quickly.

Zallea Expansion Joints are available in diameters from 3 inches to 30 feet . . . for temperatures from sub-zero to 1600° F. . . . for pressures from vacuum to 300 psi in standard designs, and up to 2,000 psi in special designs.

The next time you are faced with an expansion problem, get in touch with us. We will be glad to survey your situation and recommend the most practical and economical solution. Zallea Brothers, 820 Locust Street, Wilmington 99, Delaware.

For detailed information on Zallea Expansion Joints and services write today for a free copy of Bulletin 331.

Zallea
EXPANSION JOINTS



Engineers' Reference Books

Published by
The American Society of Mechanical Engineers

METALS ENGINEERING DESIGN

Published December 1953. $10.00—The first of four volumes of the ASME Handbook to be published, this book discusses the essential properties which need to be evaluated by the design engineer in his selection of one material over another. Comprising 48 sections and written by 43 well-known authorities, it deals with the over-all problem of selection of material and takes up such specific items as high temperature considerations, plasticity, residual stresses, vibration, fatigue, shot peening, cold working, nitriding, flame strengthening, impact, corrosion, non-destructive testing, surface finish and mass production, and design theory and practice.

MANUAL ON CUTTING OF METALS WITH SINGLE POINT TOOLS

Published 1953. $10.00—This book contains shop-tested data on the machining of high nickel alloys, stainless steels, copper and brass alloys, magnesium, cast irons and plastics. It offers valuable information on the structure of the metals to be machined, the correct tool material, size and shape of cut, and the proper cutting fluid. It shows how to predetermine the power requirements and best operating speed for all jobs. It helps time study men to set standards of practice and cost of production, and it provides 322 tables of cutting speeds and horsepower for various feeds and depths of cut when turning commonly used steels and cast iron.

GENERAL DISCUSSION ON HEAT TRANSFER

Published November 1952. $10.00—This is an authoritative reference on a decade's development in heat transfer and in the design of apparatus relating thereto. The 93 contributions and discussions in its 500 pages provide first-hand information on heat transfer with change of state; heat transfer between fluids and solids; conduction in solids and fluids; radiation, instrumentation, measurement techniques and analogies; special problems such as heat transfer in turbine blade cooling, in liquid metals, in gas turbines, in piston engines, the mercury boiler, etc.

SHOCK AND VIBRATION INSTRUMENTATION

Published 1952. $3.00—Concerned with the characteristics of shock and vibration instruments, and their use in testing, this book describes the behavior of conventional spring-mass damping instruments, peak reading gages, reed gages, and statistical gages. It discusses methods of calibration, sources of error and secondary effects, and applications of instrumentation to broad fields such as to studies of blast effects and ship vibration.

HIGH PRESSURE MEASUREMENT

Published 1953. $3.00—The fourteen treatises in this book bring you first-hand information on the following subjects. Piston ring as a precision measuring instrument, a high pressure wire gage using gold-chrome wire, techniques and equipment for generation of dynamic high pressures, an application of high pressure in geophysics, design of high pressure pumps suitable for pilot plant service, an automatic sensitive pressure controller, influence of residual stress on behavior of thick wall closed-end cylinders, rupture-disc design evaluation, gasket for high pressure vessels, controlled volume pumps for pressures in range of 10,000 to 30,000 psi, seals to minimize leakage at high pressures, and a static dynamic load machine for high pressure.

DYNAMICS OF AUTOMATIC CONTROLS

Published 1948. $6.00—This complete and lucid treatment of the subject has been written for engineers who use or must eventually use automatic controllers. It examines the functional elements of a control, surveys and describes the mathematical methods of handling control problems, deals with the important components of the control loop, and specific control problems, considers the causes of nonlinearities in the control loop, and the on-off controller and its field of application. The theory of excursion-dependent periodic regulation is fully covered, formulas for the Laplace transformation are given and the essential concepts concerning difference equations are presented.

FREQUENCY-RESPONSE SYMPOSIUM

Published November 1953. $5.00—Covering the major aspects of the frequency-response approach in its present form, this volume offers a survey of sine wave generators, with special emphasis on the low frequency pneumatic type required for process control work; performance data and features of twenty-four sine wave generators; frequency design criteria; and standards for presentation of data. Its theoretical papers treat the problems of calculating transient response from frequency response, choosing optimum controls for given physical systems, calculating nonlinear phenomena, the Evans root-locus methods, and Wiener's statistical approach to automatic-control problems. The papers concerned with applications discuss gas turbines, hydraulic servomotors, chemical plants, power systems, backlash in gear trains, and related topics.

SMALL PLANT MANAGEMENT

Published 1950. $6.50—This is a well rounded management aid which will help you in setting up an internal organization that will function smoothly, in choosing the production process, in machine and equipment planning, and creating a good distribution system. Pertinent topics discussed are financing and banking, how to organize the plant, principles of scientific management, rating products, choosing the legal form of the organization, getting the best workers and labor relations, technical research, obtaining the best facilities and materials, and about everything else that would be likely to interest an individual or a group planning to start a small manufacturing business.

REHEAT TURBINES AND BOILERS

Published 1952. $2.00—Aspects of reheating treated include advantages and disadvantages of the reheat cycle; normal, start-up, quick start-up, and shutdown of modern reheat boilers; design factors relating to performance and operation of reheat boilers; performance of several new reheat boilers and special features of operation; starting schedules after shutdown of various durations; reheat economies; conversion to centralize control of auxiliaries; temperature control; turbine overspeed control as affected by reheat; and reheat development during the past twenty-five years.

TEST CODE FOR GAS TURBINE POWER PLANTS

Published 1953. $1.50—Shows how to performance test gas turbine power plants and components. Specifies necessary instruments and testing apparatus to use, and gives instructions for computing and tabulating result.

TEST CODE FOR STEAM TURBINES

Published 1949. $2.00—Provides standard methods for testing all types of modern steam turbines as well as complete instructions for making the necessary pressure-temperature and flow measurements, and for making corrections to test performance.

POWER BOILER CODE

(Section 1) Published 1953. $3.00—This Code consists of the construction rules and an extensive appendix containing matter which is not mandatory unless referred to in the code. Rules apply to stationary boilers, unfired steam boilers, pipe connections up to and including the valve or valves, superheaters, economizers, and other pressure parts connected directly to the boiler without intervening valves.

BOILERS OF LOCOMOTIVES CODE

(Section III) Published March 1953. $1.25—The rules of this Code apply to boilers which are not subject to federal control. They cover such details as materials, working pressures, thickness of plates and tubes, riveting, valves and fittings, welding, and stamping.

LOW-PRESSURE HEATING BOILER CODE

(Section IV) Published 1953. $1.25—This is the code to consult for rules covering the construction of steel plate and cast iron steam and hot water boilers—the former to be operated at pressures not exceeding 15 psi and the latter at pressures not exceeding 150 lbs. or temperatures not exceeding 250 F.

MINIATURE BOILER CODE

(Section V) Published April 1953. $1.00—These construction and fabrication rules are for boilers that do not exceed the following limits: 16 in. inside diameter of shell, 42 in. over-all length of outside to outside of head at center, 20 sq. ft. water heating surface, and 100 psi maximum allowable working pressure.

1952 ASME UNIFIRED PRESSURE VESSEL CODE

Section VIII. Published March 1953. $4.50—This Revision covers the use of all classes of materials and methods of fabrication that have been approved for Code construction. Its specific requirements are for fabrication of vessels of carbon and low-alloy steels, nonferrous materials, high-alloy steel, cast iron, and clad and lined materials by riveting, welding, forging and brazing.

WELDING QUALIFICATIONS

(Section IX) Published 1952. $1.00—These rules apply to the qualification of welding procedures and welder performance for all types of manual and machine arc and gas welding processes permitted in other sections of the Code; and to testing welders ability to make sound welds.

ASME SCREW THREADS MANUAL FOR SHOP AND DRAFTING ROOM

Published March 1953. $2.50—The Manual gives shopmen a practical substitute for the American Unified Standards for Screw Thread and their Gages. It contains only the most used and essential standard dimensions, i.e., coarse, fine, and 8-pitch series of classes 2A and 2B from the smallest to those of 1½" nominal diameter, concise descriptions of the thread features and applications, and important related information not found in the Standards.

GLOSSARY OF TERMS IN NUCLEAR SCIENCE AND TECHNOLOGY

Published 1953. $7.00—As the standard authority on nuclear terms, this Glossary should prove exceptionally useful. It not only places some 2000 terms at your finger tips but it affords you with an opportunity to become acquainted with newly-coined terms used in and outside of your own sphere of activity. Terms defined are those peculiar to the field of Physics, Reactor Theory, Reactor Engineering, Chemistry, Chemical Engineering, Biophysics and Radiobiology, Instrumentation, Isotopes Separation and Metallurgy as well as terms used in each of these fields in a different sense or with different emphasis from what is most commonly understood in other connections, and those used elsewhere in the same way but so infrequently as to be unfamiliar. An index shows at a glance the section in which each term and its definition will be found.

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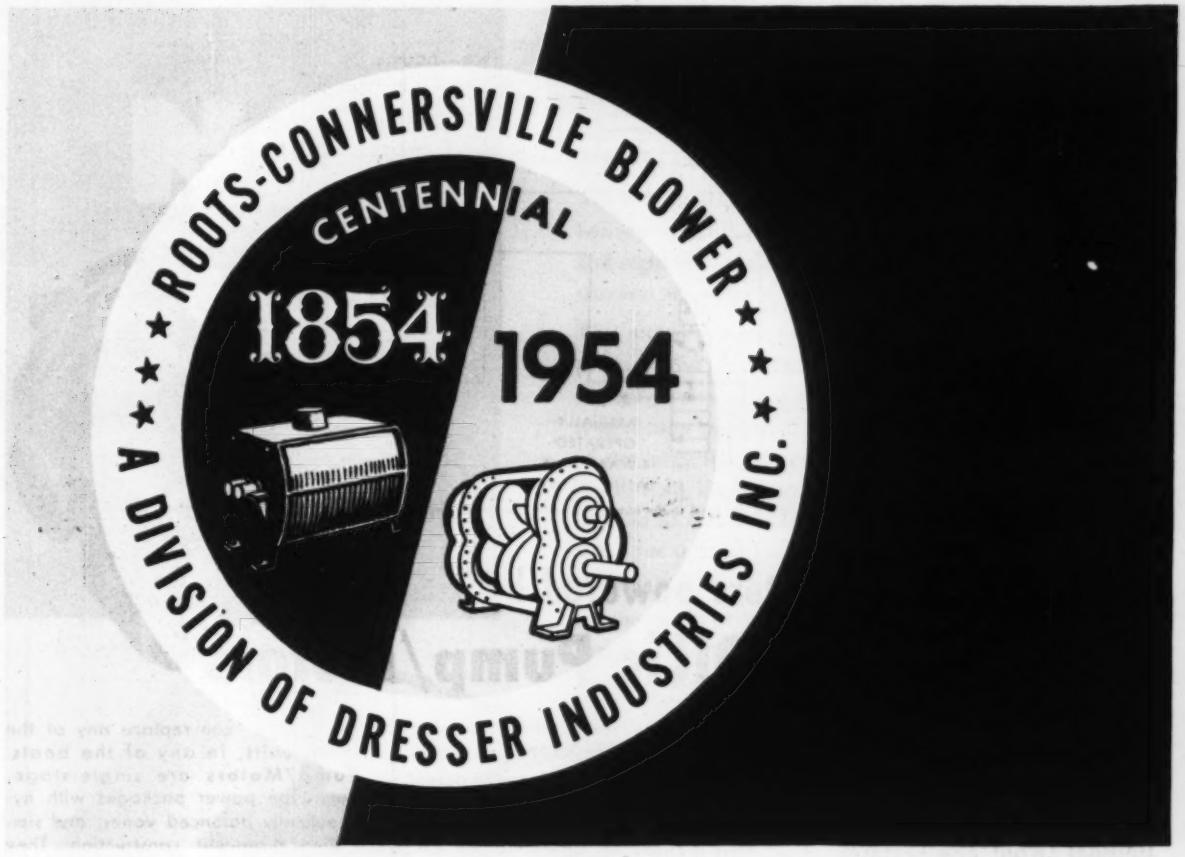

Air-handling specialists for 100 years

Starting in 1854 with the invention of the Rotary Positive Blower by our founder, Francis M. Roots, our company's services to industry were, for many years, devoted exclusively to air-handling problems.

As industry developed new applications of gases for fuels and chemicals, it was a natural step for us to move into this field because the general principles of moving and measuring air and gas are so closely similar.

Thus, Roots-Connersville service has been widened to include seven basic types of equipment for handling gas or air. The most recent development has been the new Spiraxial Compressor, first marketed in 1953.

So, for a century we have been engaged exclusively as specialists in handling gas and air. That is our only business. We like to think that this is one of the important reasons why Roots-Connersville equipment has been so widely accepted and has proved so satisfactory in every industry where processing involves the movement of air or gas.

The growth which we have experienced over 100 years could not have been possible without the loyal support of our many thousands of customers. We thank them for this evidence of good will—and we offer the same high type of equipment and service to any industry that has a problem of moving gas or air.

ROOTS-CONNERSVILLE BLOWER

Reg. U.S. Pat. Off.

BLOWER BUILDERS SINCE 1854

A DIVISION OF DRESSER INDUSTRIES, INC.
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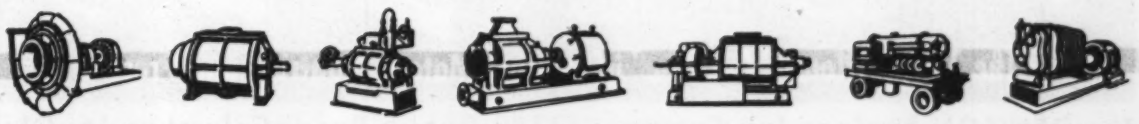
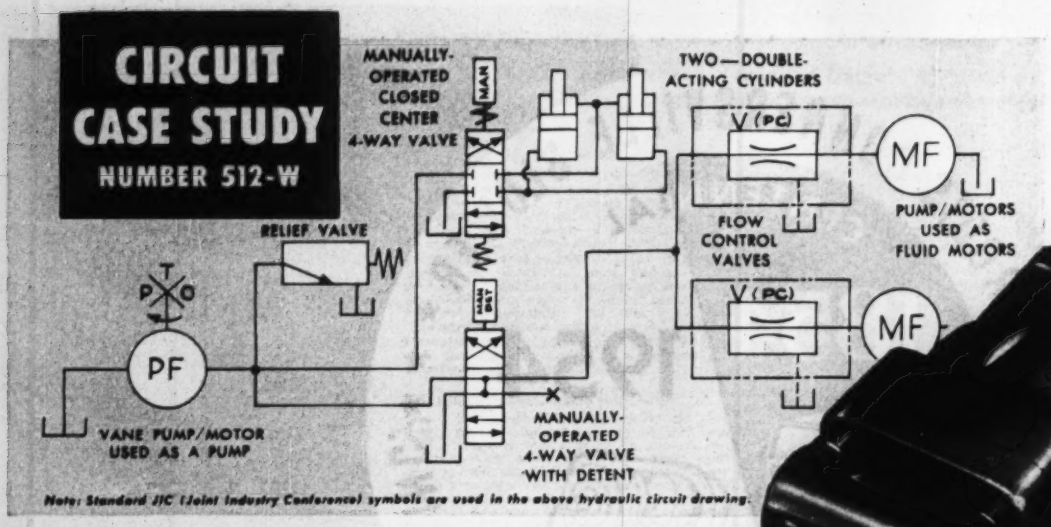


Centrifugal and Rotary Positive Blowers and Exhausters • Positive Displacement Meters • Vacuum Pumps • Gas Pumps • Inert Gas Generators • Spiraxial Compressors



Underwater weed-cutters powered by DENISON HydrOILic Pump/Motors

Unusual Circuit Also Features Denison Valves and Controls

Denison Controls and **Pump/Motors** power triple cutter bars in a fleet of boats specially developed to clear shallow inland waterways of weeds and other vegetation.

The circuit, shown above, affords positive control and power to three cutter bars, mounted on each side and across the bow of the boats. It replaces a complex, hazardous mechanical setup of open, rotating shafts, gears, pulleys, chains and belts.

The gasoline engine which powers the boat also drives a Denison **Pump/Motor** which acts as a pump.

Two additional **Pump/Motors**, one at the rear of each side-mounted cutter bar, drive the cutters through 5-to-1 reduction gearing and eccentrics. Drive rods delivering power to the cutters are interconnected by bell cranks.

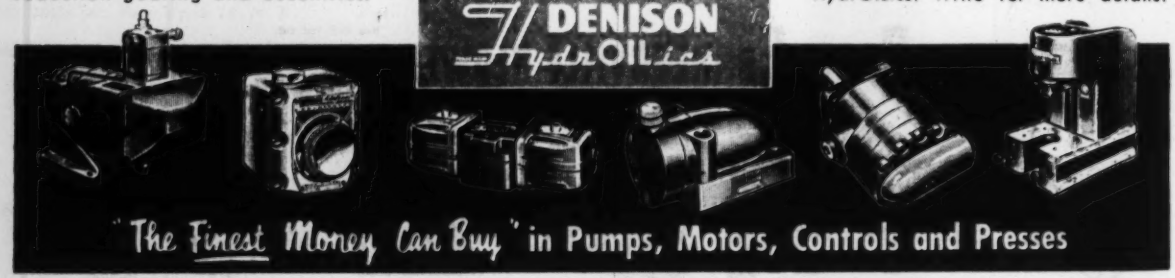
A Denison 4-way valve, with detent, controls these two **Pump/Motors**. The detent permits the operator to leave the valve in either the "operating" or "off" position without holding the lever.

A Denison relief valve limits system pressure to the maximum pre-set rating. The mechanical linkage formerly used was subject to severe damage if the cutters struck an obstacle. Now, however, the cutters merely stall, and excess flow "spills" through the relief valve.

A second Denison 4-way valve with a closed-center spool controls double-acting cylinders which raise and lower the cutter bars. By simply centering this valve control, the operator can hold the cutters at any height.

This type of circuit emphasizes advantages of Denison **Pump/Motors**. Each unit is ready for either pump or motor duty *without alterations!* A single "spare" can replace any of the three units, in any of the boats. **Pump/Motors** are single-stage, vane-type power packages with hydraulically balanced vanes, and simplified three-unit construction. They stand up under *long, hard, continuous duty* at pressures up to 2000 psi. Four sizes—each with a choice of cam rings for different needs—offer pumping capacities from 3 to 82 gpm . . . motor capacities from 8 to 98 hp (13 to 257 inch-pounds of torque per 100 psi.) All models can provide either clockwise or counterclockwise rotation.

Denison offers an outstanding line of high pressure oil hydraulic pumps, motors and controls, for pressures to 5000 psi. Designed with skill and knowledge gained through twenty-five years of leadership in oil hydraulics, they have the compact ruggedness needed for exacting, heavy-duty demands. Wherever you need closely adjustable power and control with unlimited operating flexibility, specify HydrOILics. Write for more details.



The DENISON Engineering Company, 1189 Dublin Road, Columbus 16, Ohio

NO Reducing Valve Needed

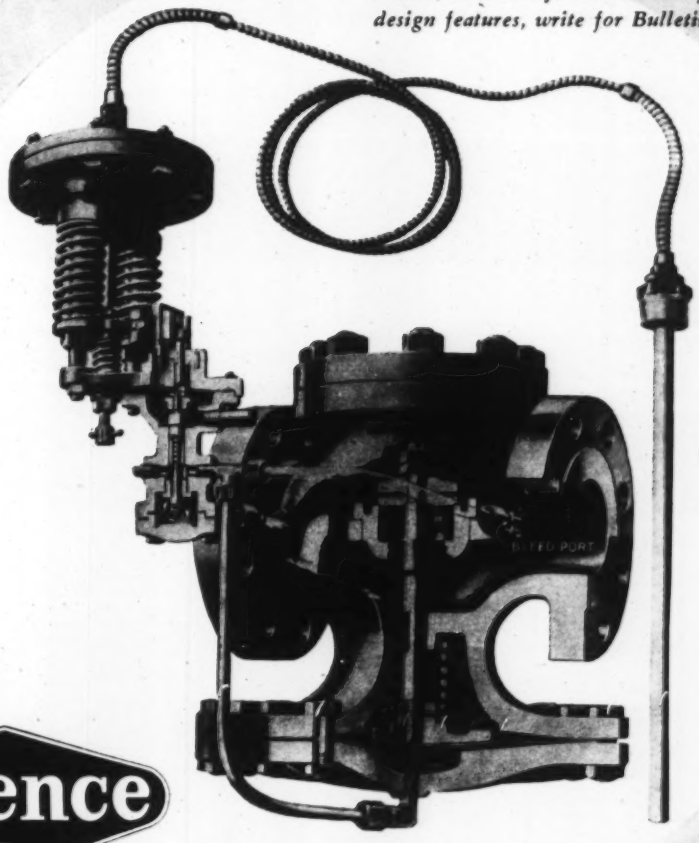
Here's real economy in temperature control.

Because Spence Temperature Regulators are designed to limit heater steam pressures to an adjustable maximum, the need for a separate reducing valve is completely eliminated.

The Spence Regulator takes steam directly from the boiler or high pressure line, reduces the pressure and regulates the flow as required to maintain a constant temperature output from the heater.

This means one relatively small combination pressure and temperature regulator replaces a reducing valve of the same size and a larger temperature regulator. Practically the entire cost of the large separate temperature regulator is saved. And, the total saving would also include the cost of a 3-valve by-pass along with all labor for installation.

This design feature is just one of the reasons for the thousands of Spence installations throughout American industry. *For details of other important design features, write for Bulletin T50.*

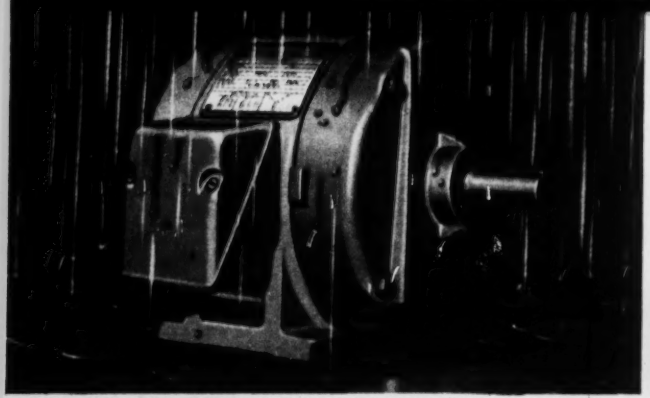


SPENCE
TYPE ET150
Temperature
Regulator

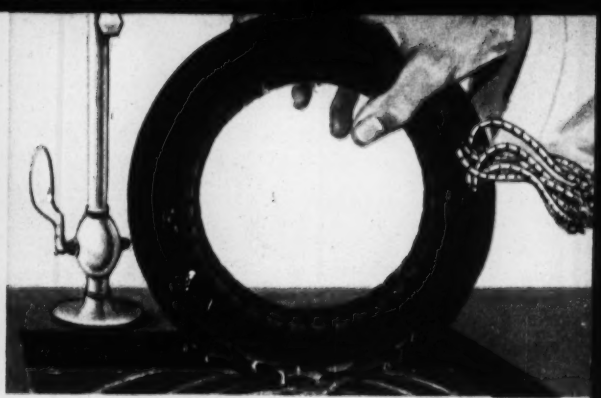
Spence

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

YOU GET EVEN LONGER MOTOR LIFE



PHYSICAL PROTECTION INCREASED 60 PER-CENT by a complete redesign of cast-iron frame and end shields. This motor is suitable for many jobs where ordinary dripproof motors should not be applied.



EXTRA ELECTRICAL STRENGTH is assured by use of new polyester film insulation. A silicone coating, Dri-film.* virtually eliminates stator insulation failure caused by moisture.

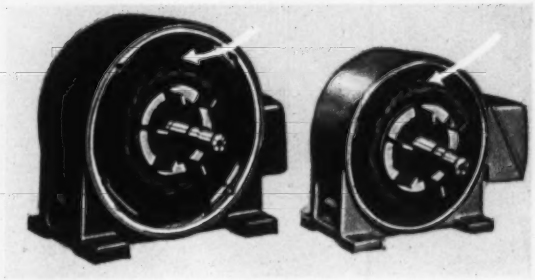
*REG. U.S. PAT. OFF.

TRI 55 CLAD THE LEADER IN MODERN MOTOR DESIGN

GENERAL ELECTRIC ANNOUNCES...

THE ALL-NEW TRI 55 CLAD MOTOR

REG U.S. PAT OFF.



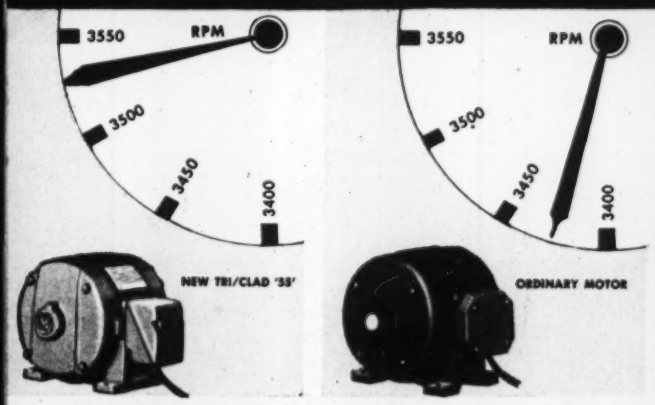
LIGHTER, SMALLER Tri/Clad '55' motors have been made possible through better use of space within the frame. Active materials (magnetic steel, copper) have not been sacrificed.

Complete Line of Dripproof, Enclosed Motors and Gear-Motors Available in Most Ratings in 1954

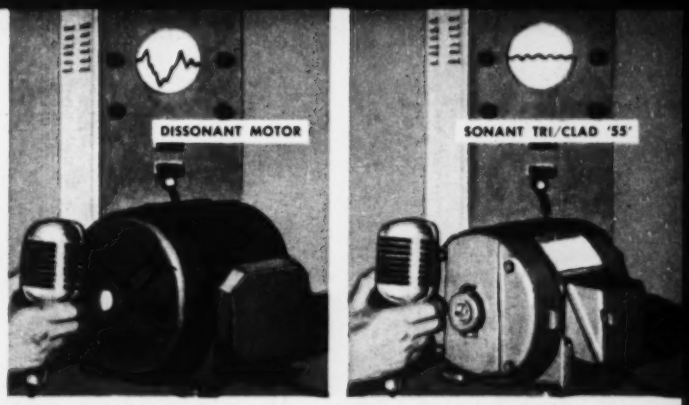
Here's the all-new Tri/Clad '55' motor — now available in NEMA 182 and 184 frame sizes.

You can get complete information on this dramatic motor achievement by writing for bulletin GEA-6013 on Tri/Clad '55' Dripproof motors, GEA-6012 on Tri/Clad '55' Enclosed motors, or GEA-6027 on Tri/Clad '55' Gear-motors, or by contacting your nearby G-E Apparatus Sales Office or G-E Motor Agent. General Electric Company, Section 648-1, Schenectady 5, N. Y.

YOU GET EVEN BETTER PERFORMANCE



HIGHER FULL-LOAD SPEEDS is only one of many improved characteristics of this new G.E. motor. Above shows comparison of an ordinary motor with the Tri/Clad '55' — both rated at 3600 rpm.



SONANT OPERATION of the new Tri/Clad '55' motor has been laboratory tested and proven. Motor operates at reduced noise level, and operating sound is pitched to a more pleasant frequency.

YOU GET EVEN MORE INSTALLATION AND MAINTENANCE SAVINGS

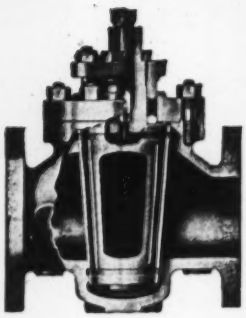
NEW BEARING SYSTEM allows this motor to run longer than other motors without regreasing. One reason—greatly improved synthesized grease with 8 times the mechanical stability of ordinary grease.

EASIER TO SERVICE, the new Tri/Clad '55' has larger conduit box diagonally split for simplified wiring. Perma-numbered leads mean that even clipped and stripped wires are instantly identified.

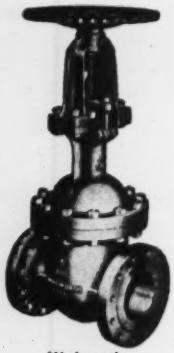
Progress is our most important product

GENERAL ELECTRIC

• VALVES
• PIPE FITTINGS

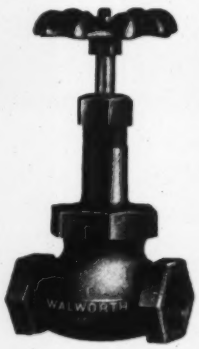


Walworth
Lubricated Plug Valve



Walworth
Steel Gate Valve

Walworth
Iron Body Gate Valve



Walworth
"500 Brinell" Bronze Globe Valve

Walworth
Iron Body Saddle Gate Valve

Walworth
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Walworth manufactures a *complete line* of valves and pipe fittings: all made to the highest standards of quality, both as to dimensional accuracy and metallurgical properties. In design, construction, and performance, Walworth products reflect more than a century of experience in the manufacture of quality valves and fittings.

Your Walworth distributor will give you full information on the *complete line* of Walworth steel, iron, and bronze, and special alloy valves and pipe fittings; also Walworth Lubricated Plug Valves, and Walseal* valves, fittings and flanges. Ask for this information today.

*Patented—Reg. U. S. Pat. Off.

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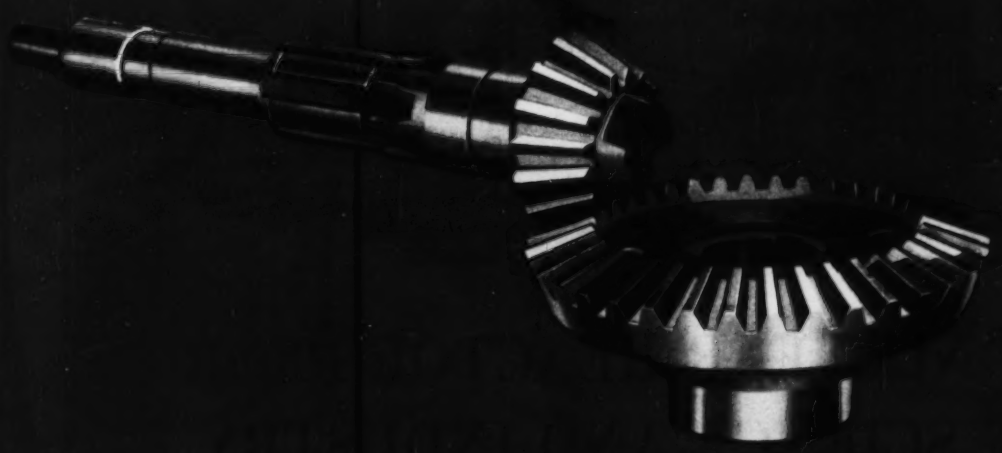
GEARS

for every purpose



Skilled Illinois Gear craftsmen are at your command to produce gears for every purpose—from gears rotating the earth, grinding weight of 100 ton rounds to gears controlling the speeds of large cylinders that speed delicate sheets through paper mills at thousands of feet per minute.

With the finest precision gear making equipment available anywhere Illinois Gear can fill your orders on time and meet your most demanding specifications.

Send your next order to Illinois Gear!

ILLINOIS GEARS
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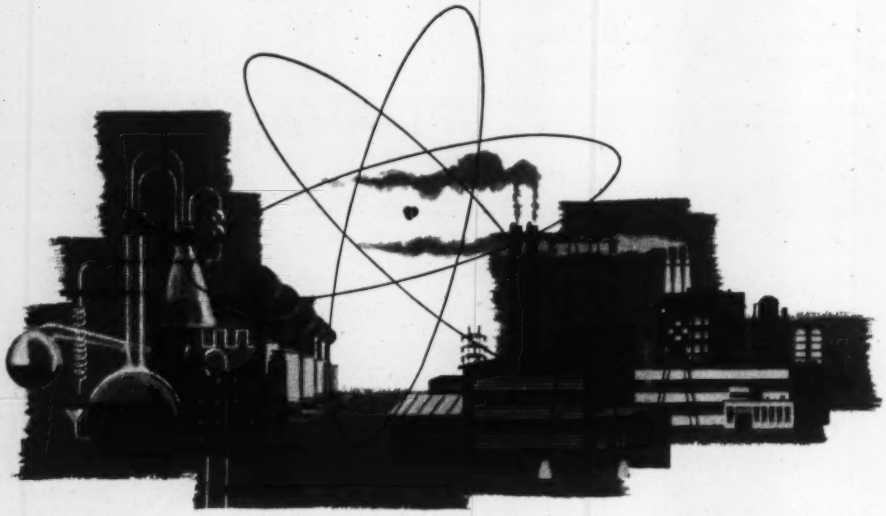
Gears for Every Purpose ... one gear or 10,000 or more

ILLINOIS GEAR & MACHINE COMPANY

NORTH AMERICAN AVIATION
is ready to build



NUCLEAR REACTORS FOR SCIENCE AND INDUSTRY

North American Aviation is ready now to design and build nuclear reactors to fit the research and power production needs of any qualified educational, medical or industrial group.

As in the case of proposals now in process, North American will provide all engineering services necessary for reactor development and operation, offering the widest possible range of reactor application. North American is also prepared to supply accessory equipment . . . as well as a variety of services essential to the success of various atomic projects.

Through its work with the Atomic Energy Commission and other government agencies, North American has developed one of the most complete atomic research and production facilities to be found in private industry . . . staffed by one of the nation's largest groups of outstanding engineers and scientists.

North American invites your inquiry regarding reactor development or any other project in which atomic energy can be put to productive use. All reactor development is undertaken in accordance with the provisions of the Atomic Energy Act and subject to approval of the Atomic Energy Commission.

NORTH AMERICAN AVIATION, INC.

ATOMIC ENERGY RESEARCH DEPARTMENT • DOWNEY, CALIFORNIA

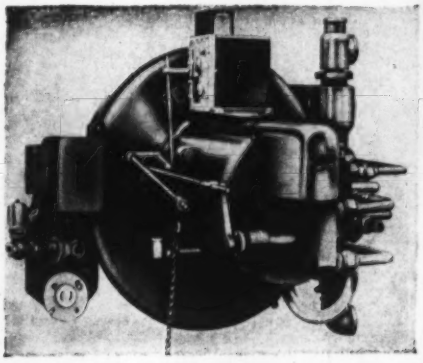
NO MATTER WHAT THE DEMAND

THERE'S A

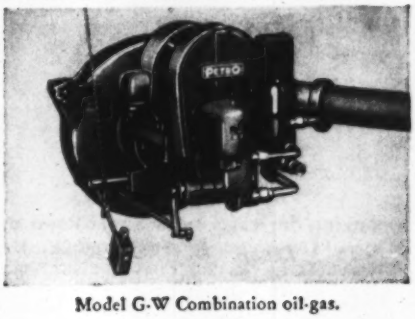
Petro

INDUSTRIAL OIL BURNER

to handle it!



Shown above Model WA for use with cold oil.
Also available Model W-AH for use with heated oil.



Model G-W Combination oil-gas.

Cut Fuel Costs with Heavy Fuel Oil

Petro rotary oil burners are built for firing all types of boilers up to 600 boiler horsepower, and also for many other industrial applications. They are designed to burn the low-cost, heavy fuel oils with complete reliability, Petro oil burners slash fuel costs two ways—they burn the *lower priced oils*, and they do it with *outstanding efficiency*. Fluctuating steam demands are answered automatically with Petro modulating flame control. Thousands of owners will tell you that Petro Industrial Oil Burners and combination oil-gas burners are fuel savers, labor savers and trouble savers, and their dependability is traditional.

Your heating contractor can tell you about Petro burners. Turn to "Oil Burners" in telephone book yellow pages. See catalog in Sweet's Architectural File, or mail coupon below.

INDUSTRIAL AND COMMERCIAL OIL, GAS AND COMBINATION OIL-GAS BURNERS, RESIDENTIAL OIL BURNERS, OIL AND GAS FURNACES AND BOILERS

PETRO

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50 Years of Leadership in Automatic Heating and Power Equipment

PETRO, 3179 W. 106th St., Cleveland, Ohio.
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Please send me the Petro catalog of commercial-industrial oil and gas-oil firing equipment.

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The magic whispers...

When Grandpa tucked you between his knees, you knew you were going to listen again to his wonderful watch—to hear its magic tick . . . tick . . . tick . . .

And as you listened, those measured whispers of time shut away the world, leaving you close to Grandpa, secure in his love.

From fathers and mothers to sons and daughters passes the lifeblood of happiness—security. The privilege of providing it for those we love can be found only in a land like ours.

And another wonderful thing is this: By realizing this privilege of freedom for ourselves, we achieve the security of our country. For, think—the strength of America is simply the strength of one secure home touching that of another.

Saving for security is easy! Read every word—now! If you've tried to save and failed, chances are it was because you didn't have a *plan*. Well, here's a savings system that really works—the Payroll Savings Plan for investing in Savings Bonds.

This is all you do. Go to your company's pay office, choose the amount you want to save—a couple of dollars a payday, or as much as you wish. That money will be set aside for you before you even draw your pay. And automatically invested in Series E U. S. Savings Bonds which are turned over to you.

If you can save only $3.75 a week on the Plan, in 9 years and 8 months you will have $2,137.30. If you can save as much as $18.75 a week, 9 years and 8 months will bring you $10,700!

For your sake, and your family's, too, how about signing up today?

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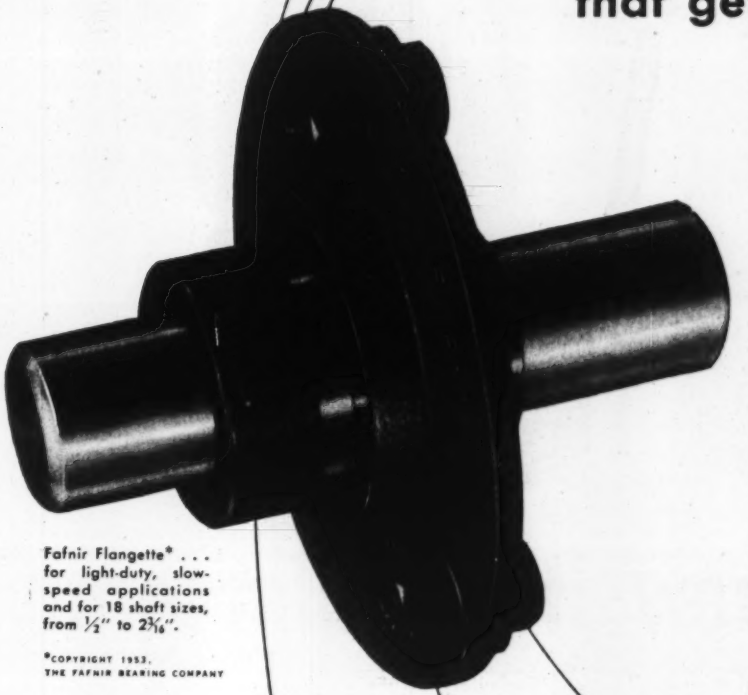
Design Strategy

that gets more for less



Fafnir Flangette* . . . for light-duty, slow-speed applications and for 18 shaft sizes, from ½" to 2 3/16".

*COPYRIGHT 1953, THE FAFNIR BEARING COMPANY

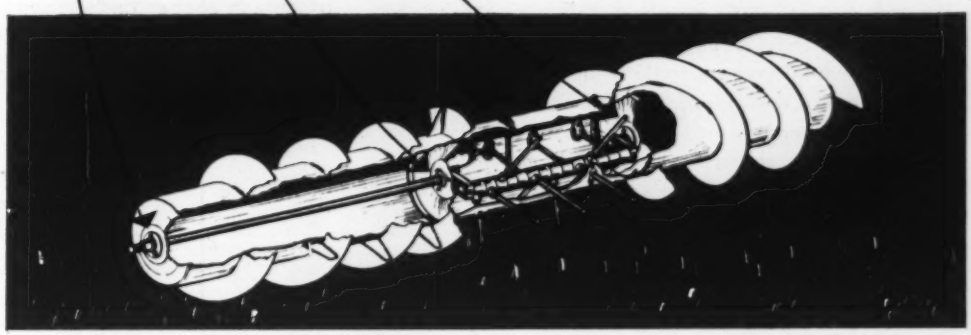
By installing Fafnir Flangettes on the loading auger shaft of a self-propelled combine, a manufacturer of farm equipment improved auger performance and reduced manufacturing costs at the same time.

Equipped with Fafnir Ball Bearing Flangettes, the auger required less power to operate, no re-lubrication, no bearing adjustments and its service life was extended substantially. In addition, whenever servicing of auger parts required disassembly and reassembly, Fafnir Flangettes saved important man-hours.

From a manufacturing angle, Fafnir Flangettes eliminated the need for fabricating bearing housings with attendant lubricating systems.

They have their *own* easily applied housings—paired pressed steel flanges, which enclose a self-aligning Fafnir Wide Inner Ring Bearing with Self-Locking Collar—easiest of all bearings to install.

The mated eccentric cam design of the bearing inner ring and collar provides positive locking action without set screws, locknuts, or adapters — eliminates shaft slippage or scoring. Efficient seals keep grease in — contaminants out.



Here is another result of the Fafnir "attitude and aptitude," a way of looking at bearing problems from the designer's viewpoint . . . an ability for supplying the right bearing to fit the need. Maybe this combination can help you solve a bearing problem. The Fafnir Bearing Company, New Britain, Conn.

FAFNIR
BALL BEARINGS

MOST COMPLETE LINE IN AMERICA

"I didn't know it was Integral"

"I didn't expect the fins to be part of the tube."

"Well, if you had to list the advantages of Wolverine Trufin*—you'd find that the integral feature would top the list.

"Because Trufin is integral, the fins are actually part of the tube. They're extruded—literally squeezed—right out of the wall of the tube. That means they'll stand up under vibration and the shock of sudden temperature changes—that there's maximum heat transfer and that Trufin can be bent, coiled and otherwise fabricated just like plain tube."

"Is that all? Are there other advantages?"

"Definitely! Trufin lets you design a much more compact heat exchanger . . . one that will provide more BTU's per foot of tubing. That means it does a better job at a lower cost. Too, Trufin is available not only in copper and copper-base alloys, but in aluminum, bi-metal, electric-welded steel and other metals."

It makes sense: If a smaller heat exchanger with a bigger punch is needed, the answer is Wolverine Trufin. It's tops in efficiency, lower in cost. Write for the Trufin data sheet today. It tells you all about sizes, fin spacings and fin heights—*everything* you need to know about Trufin.

Wolverine Trufin* and the Wolverine Spun End Process† available in Canada through the Unifin Tube Co., London, Ontario.

*REG. U.S. PAT. OFF. †A PATENTED PROCESS RE. 22465

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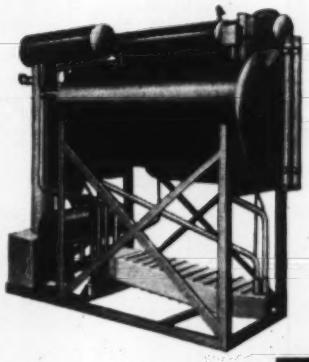
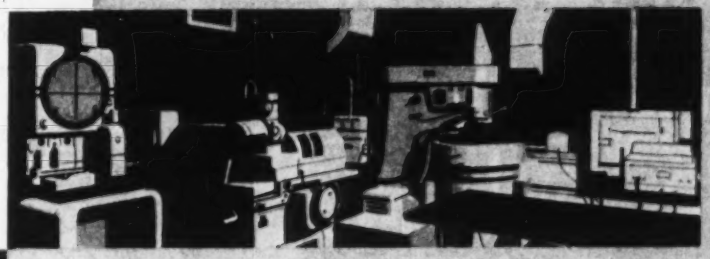
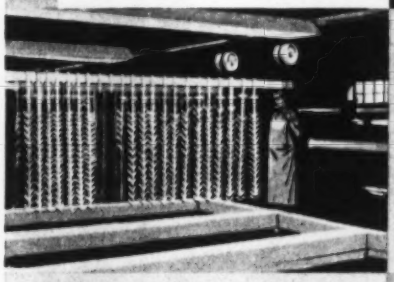
use WASTE HEAT to control HUMIDITY and TEMPERATURE



Servel 25-ton Water Chiller
No moving parts. Operates continuously at peak load with minimum maintenance on steam from any source.





Industrial Precooling
Use Servel Water Chillers to precool air and increase capacity and improve performance of compressors and internal combustion machines. Opportunities for varied and profitable use are practically unlimited!

Process Cooling
Continuous high efficiency and dependability makes Servel Water Chiller ideal for process cooling. Temperatures of liquids can be closely regulated and held to precision limits in manufacturing and formulating processes.

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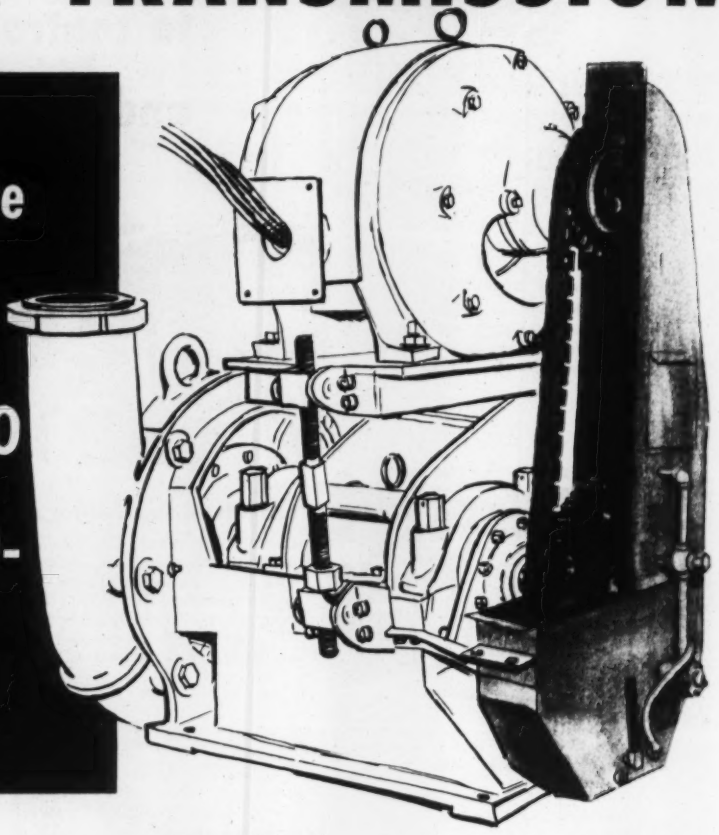
HY-VO facts for a new age in POWER TRANSMISSION

How you can save up to $1,407.00 with MORSE HY-VO on a 350-hp., 1800-rpm electric motor



Now, with Morse Hy-Vo Drives, you can gain new advantages from buying smaller, higher speed, more efficient electric motors.

You save weight, space, and electric power. And in most cases, the difference in cost between a low-rpm motor and a high-rpm motor of the needed horsepower, will more than pay for the Hy-Vo Drive. Let's look at an example:

Generally, the commonly used methods of power transmission, due to inherent restrictions on rotative speed and velocity, limit the speed of 200-hp. or larger motors to 1200 rpm. Hy-Vo's upper limits are far greater, ranging up to 3600 rpm for ¾" pitch.

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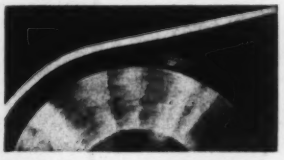

Chain follows a path truly tangent to sprocket pitch circle, thus almost eliminating chordal action. A new, balanced link design greatly improves stress distribution.

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THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

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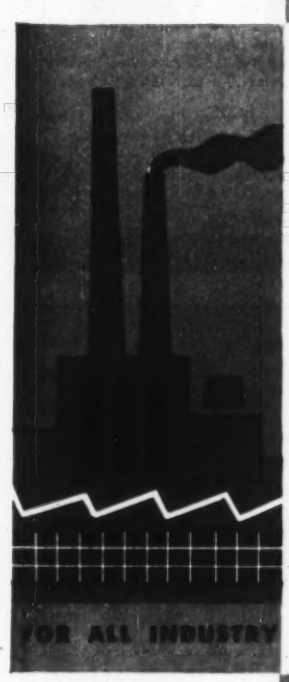

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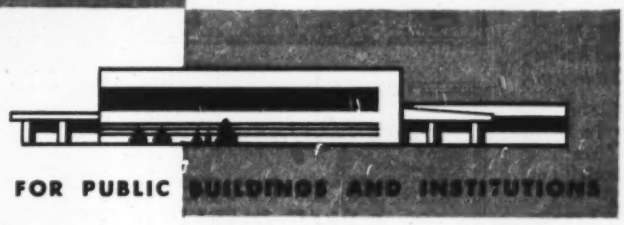

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151

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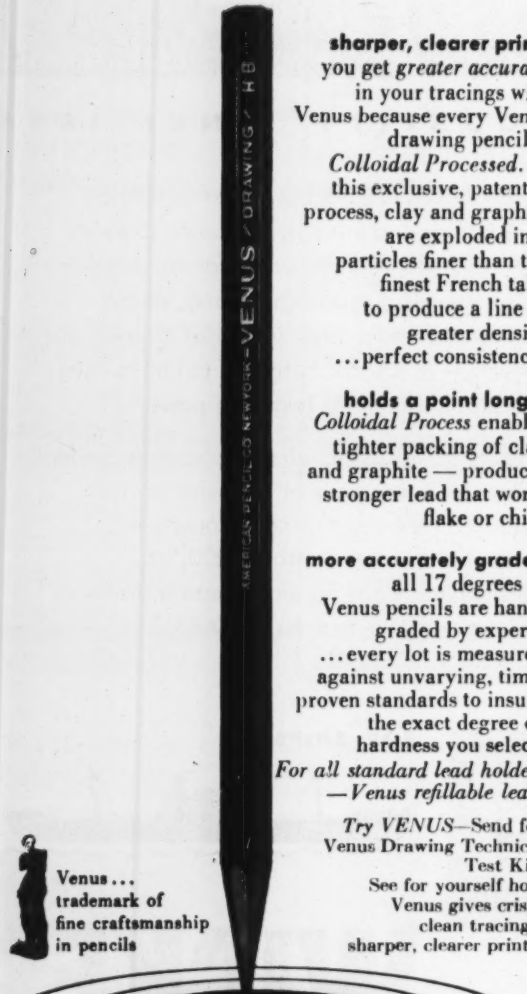

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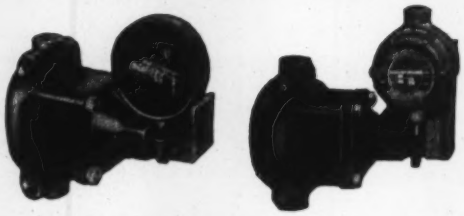

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MECHANICAL ENGINEERING

December, 1953 CARD INDEX Vol. 75, No. 12

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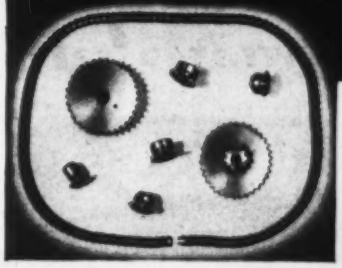

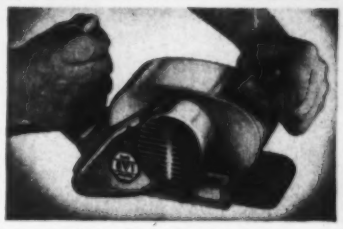

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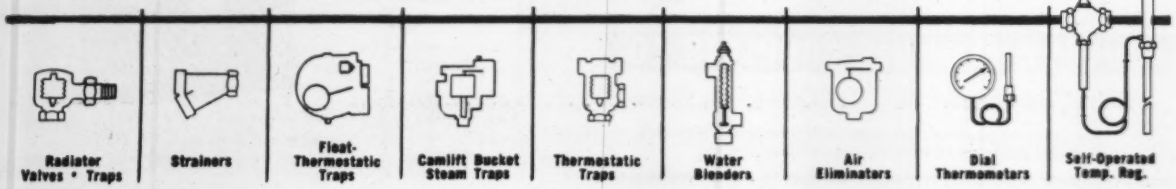

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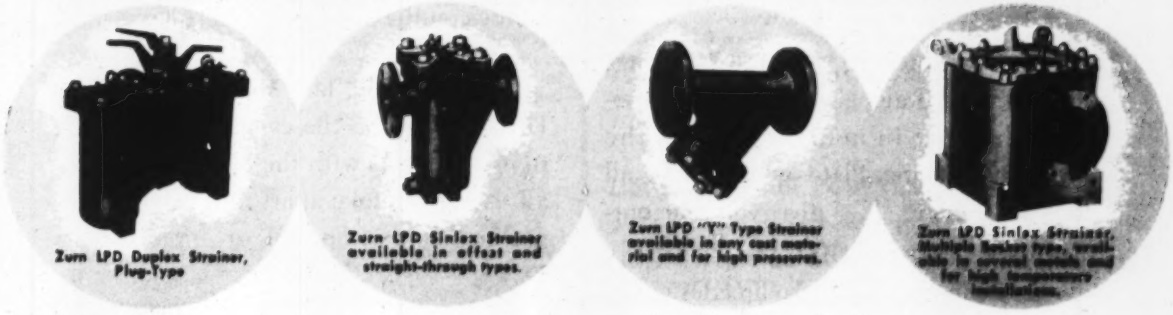

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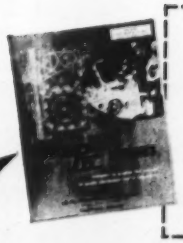

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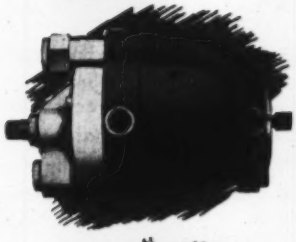

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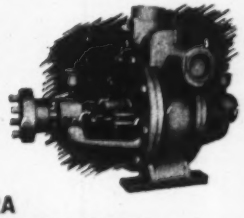

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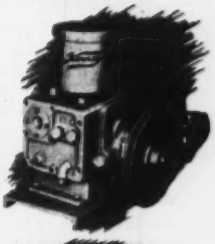

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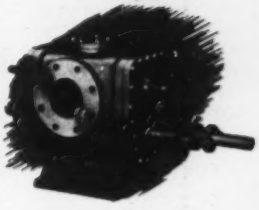

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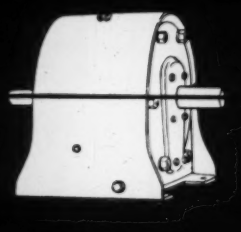

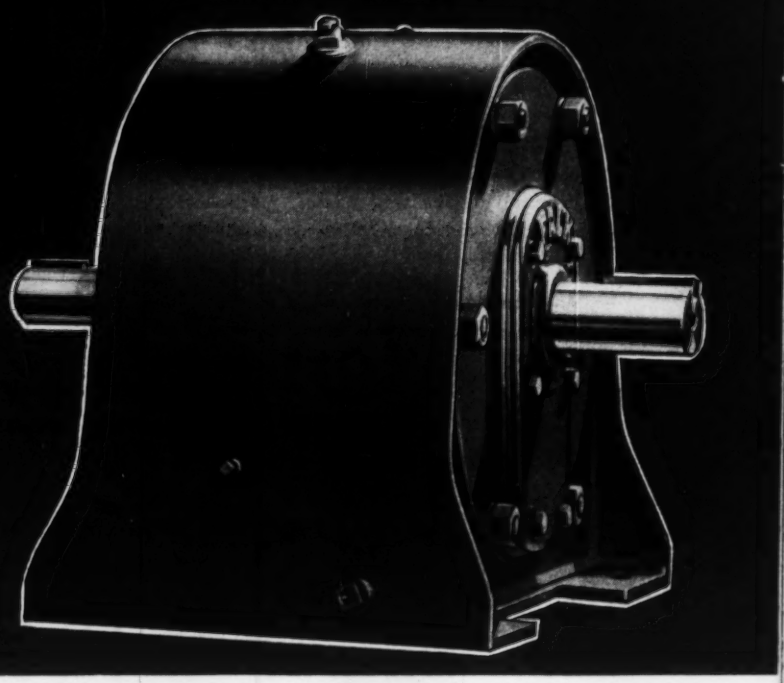

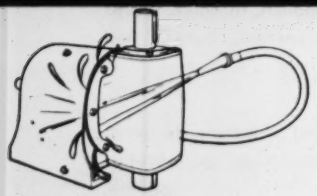

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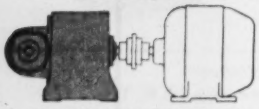

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Comparison Of Amerigear Fully Crowned Tooth Design With Gearing Of Conventional Gear-Type Couplings Shows How "End Tooth And Tip" Contact Is Practically Eliminated And Why Greater Freedom Of Axial Movement Is Provided By Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling).

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Please send me further information regarding AMERIGEAR COUPLINGS with the fully Crowned Teeth and Catalog No. 501.

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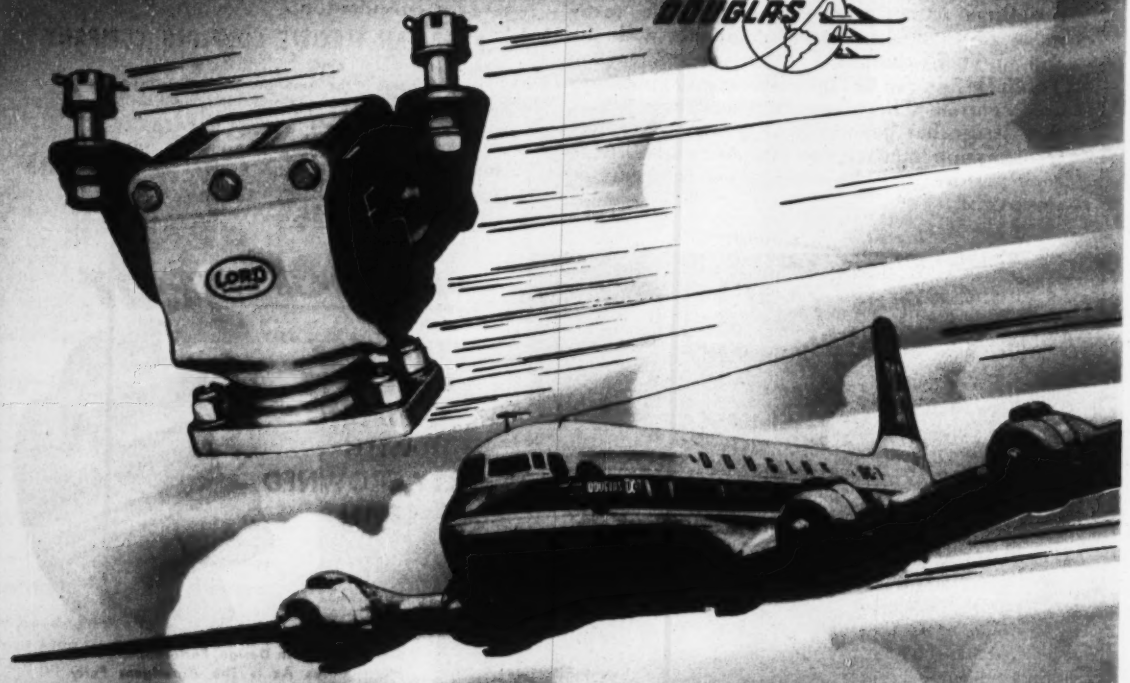

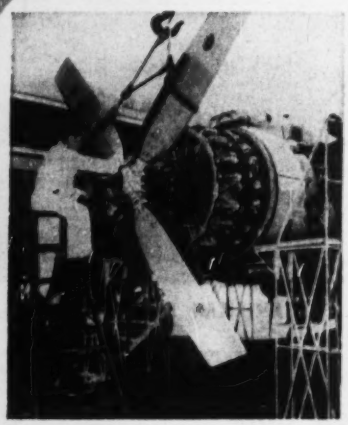

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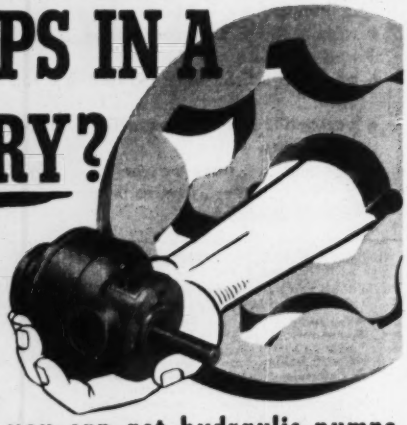

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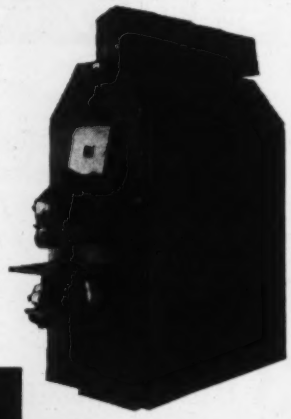

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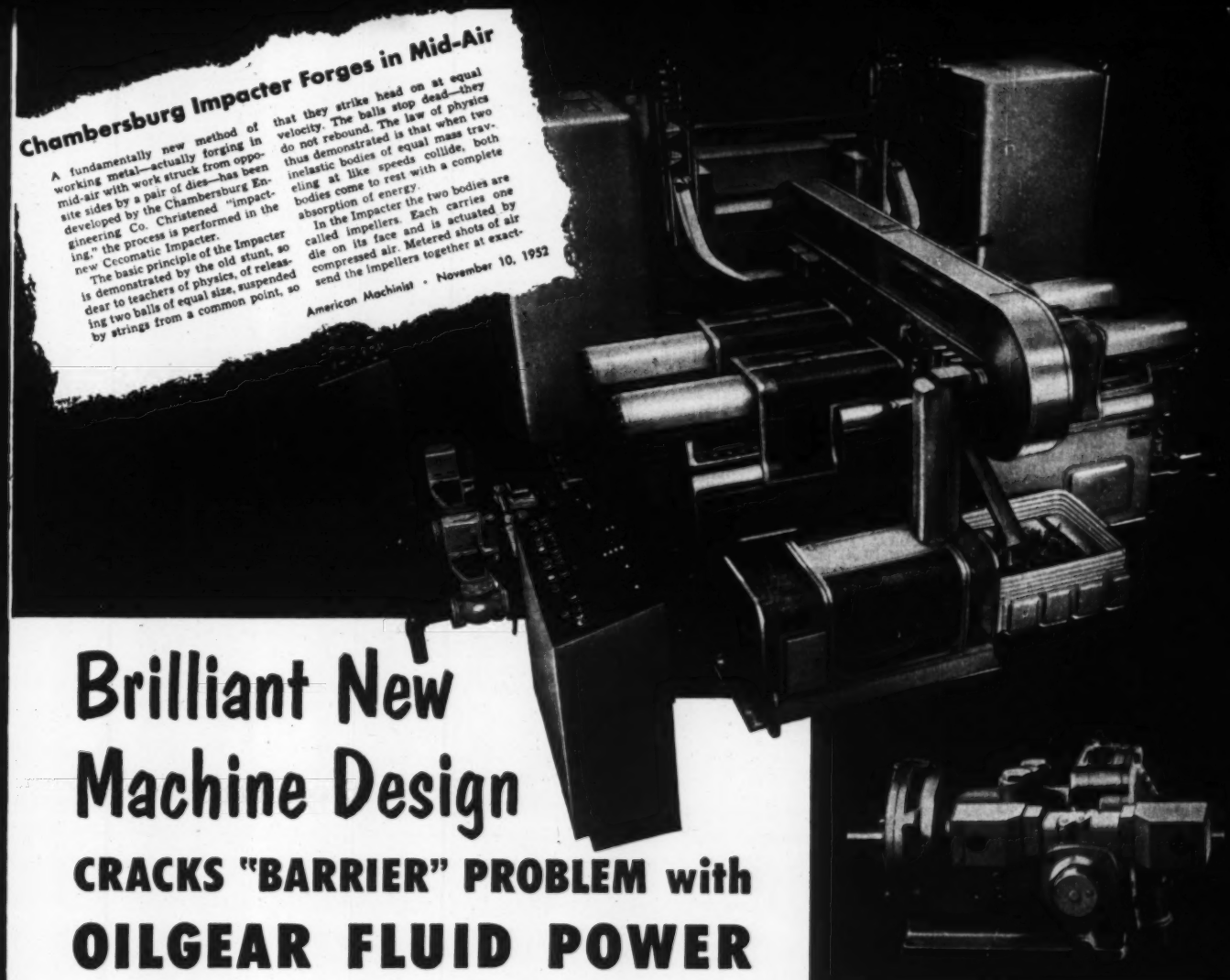
ROCKFORD CLUTCHES



Chambersburg Impacter Forges in Mid-Air

A fundamentally new method of working metal—actually forging in mid-air with work struck from opposite sides by a pair of dies—has been developed by the Chambersburg Engineering Co. Christened "impacting," the process is performed in the new Cecomatic Impacter.

The basic principle of the Impacter is demonstrated by the old stunt, so dear to teachers of physics, of releasing two balls of equal size, suspended by strings from a common point, so that they strike head on at equal velocity. The balls stop dead—they do not rebound. The law of physics thus demonstrated is that when two inelastic bodies of equal mass traveling at like speeds collide, both bodies come to rest with a complete absorption of energy.

In the Impacter the two bodies are called impellers. Each carries one die on its face and is actuated by compressed air. Metered shots of air send the impellers together at exact-

American Machinist · November 10, 1952

Brilliant New Machine Design

CRACKS "BARRIER" PROBLEM with OILGEAR FLUID POWER

Once the "forge-it-in-mid-air" idea occurred to the Chambersburg Engineering people, there were two "barrier" problems to be smashed before the idea became a brilliant reality. Something of the seriousness of the problems is indicated by the fact they spent 10 years to get the right, precise integration of movements and forces required.

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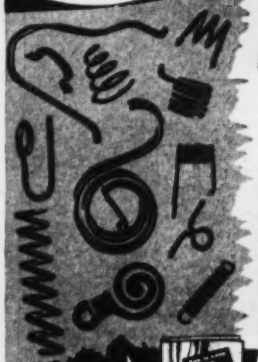

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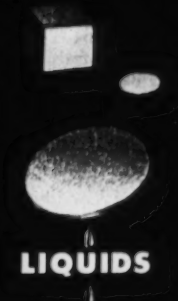

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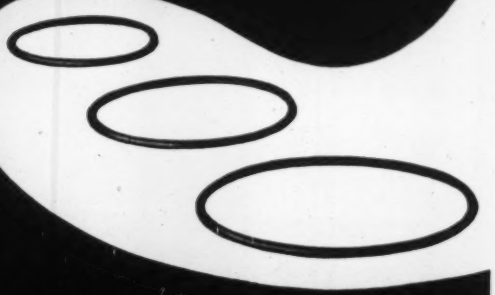

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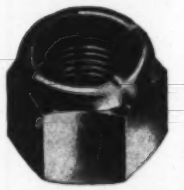

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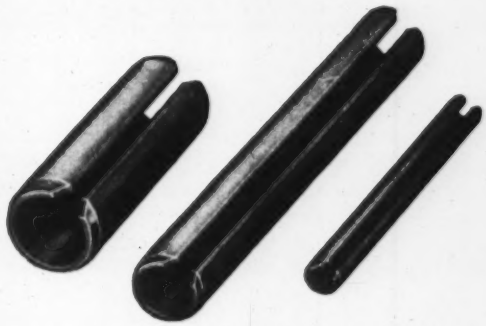

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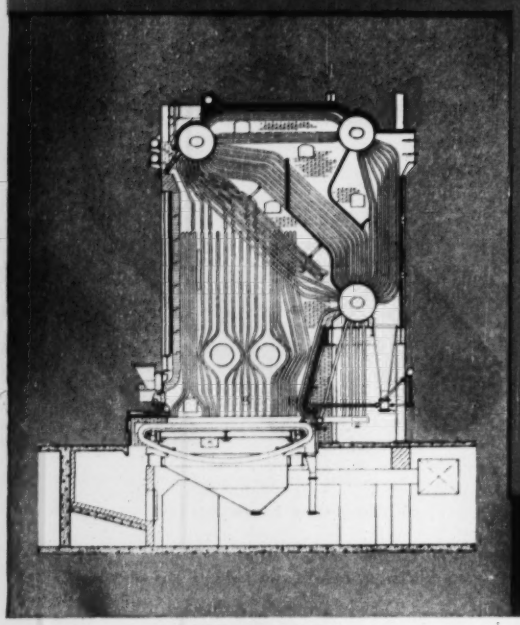

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BOILER DATA

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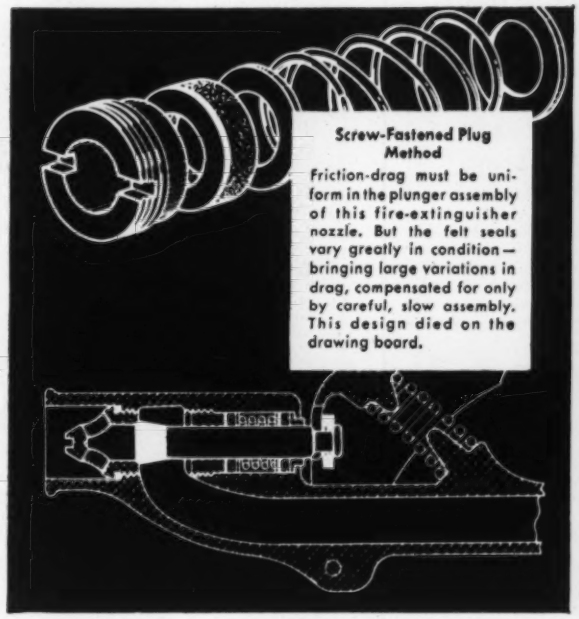
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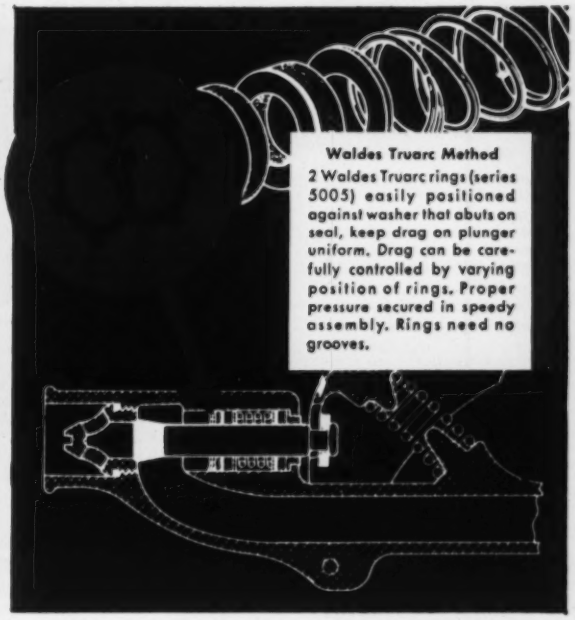
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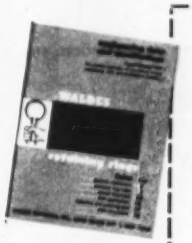

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Black & Veatch
Electrical Testing Labs.
Fiddler & Reiffin
Harza Engineering Co.
Hathaway, C. M.
Jackson & Moreland
Kendall, George H.
Kuljian Corp.
Loftus, Peter F., Corp.
Mast Development Co.
National Weld Testing Bureau
Palmer, Delos M. & Assoc.
Peacock Corp.
Polachek, Z. H.
Sanderson & Porter
Sargent & Lundy
Sirrine, J. E., Co.
Stanley Engineering Co.
Thompson, John I. & Co.
Tour, Sam & Co.

MECHANICAL ENGINEERING, 29 W. 39th St., New York 18, N. Y.

Additional information is requested on the following advertisements in the January 1954 issue.

Page No. *Name of Advertiser*

Name Title

Company

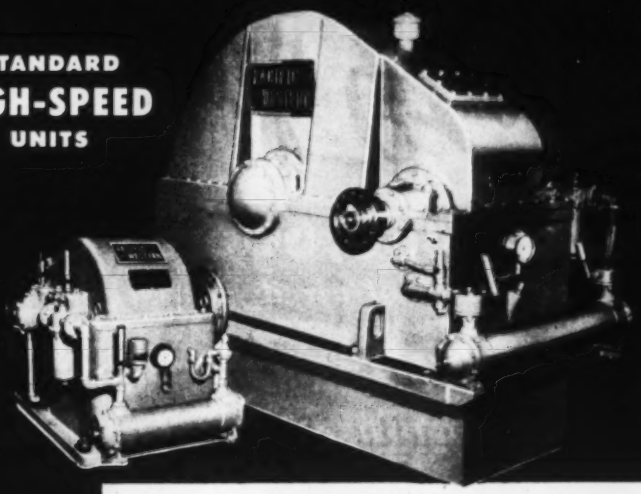
Address

City State

Reader Service Coupon For More Information

Go through the advertising pages and jot down the page numbers and names of advertisers about whose product you want additional information — mail the coupon to us — your request will be passed on to the advertiser promptly — you will hear directly from advertiser — saves your time in writing individual letters.

STANDARD
HIGH-SPEED
UNITS



SPECIAL
HIGH-SPEED
UNITS

GEAR DRIVES

custom engineered or standard

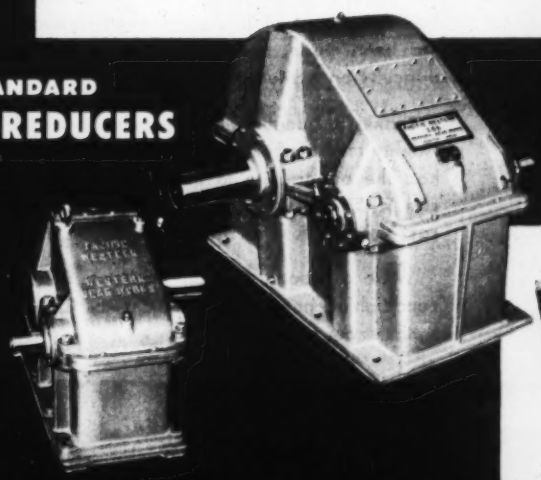
Complete services by Western Gear Works include the design, production, testing, and application of all types of gear drives for all industries.

WESTERN GEAR

"Good Gears Since 1888"

SPECIAL
AIRCRAFT
ACCESSORY DRIVES

STANDARD
SPEED-REDUCERS



Bulletins Available

Manufacturing Information No. 5200
High Speed Gear Units No. 5204
Herringbone Speed Reducers No. 4802
Agitator Drives No. 5308
Right-Angle Speed Reducers No. 5203

WESTERN GEAR WORKS

Manufacturers of **PACIFIC-WESTERN** Gear Products

Pacific Gear & Tool Works

Plants Seattle
San Francisco
Belmont
(S. F. Peninsula)
Lynwood
(Los Angeles County)
Pasadena
Houston

in 25 years....

2,228,460,000,000
cubic feet of air delivered!

without major mechanical difficulty of any kind

EVERY CLARAGE FAN
EVERY CLARAGE WASHER
STILL ON THE JOB!

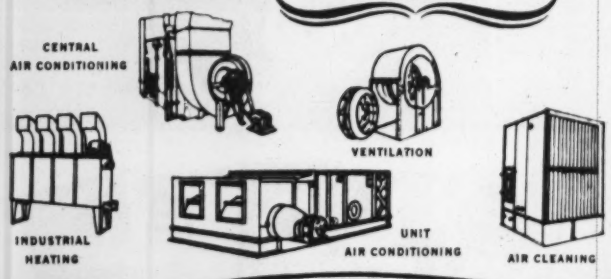
In June 1928, Fidelity-Philadelphia Trust Company, placed in operation its Clarage equipment —40 fans and 4 air washers.

Today the same 40 Clarage fans and the *same* 4 Clarage washers provide efficient, dependable ventilation for this great office building —and they are apparently good for another quarter-century of service.

In handling over two and one quarter trillion cubic feet of air, not a single replacement has been made, nor a single major mechanical difficulty encountered.

Thanks to adequate maintenance on the part of Fidelity management, this Clarage equipment has had the opportunity to prove our slogan: **"You can RELY on Clarage"—RELY on Clarage to cost you far less in the long run.**

Write us about your air handling and/or air conditioning needs...CLARAGE FAN COMPANY, Kalamazoo, Michigan.



You can Rely on...

CLARAGE

Headquarters for Air Handling and Conditioning Equipment

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA Canada Fans, Ltd., 4285 Richelieu St., Montreal

Robert Shaw Dormitory

MICHIGAN STATE COLLEGE

EAST LANSING, MICHIGAN

ARCHITECT: Ralph R. Calder*

ENGINEERS: Snyder & McLean*

GENERAL CONTRACTOR
Christman Company†

MECHANICAL CONTRACTORS
Hickey, Shaw & Winkler*
*Detroit †Lansing

POWERS
TEMPERATURE CONTROL

Selected For The Heating And Ventilating System *And* **180** *Individual Shower Baths*

No compromise with safety or comfort in showers here.

After thorough tests and comparison with other shower regulators, Powers thermostatic water mixers were installed in Shaw Dormitory. Here are some of the reasons why:

1. In a shower regulated by a Powers mixer—there's no danger of scalding nor slipping and falling while trying to dodge a "shot" of hot or cold water due to **pressure** or **temperature** changes in water supply lines.

2. Failure of cold water supply to a Powers mixer instantly and **completely** shuts off the shower delivery.

3. A sudden 100° F. rise in hot water supply is barely noticeable in a shower regulated by a Powers mixer. Being thermostatic it protects bathers from scalding caused by "dead ends" in hot water supply lines.

4. Temperature of shower is **thermostatically** limited to 115° F.

Why risk shower accidents, unfavorable publicity and time consuming law suits? It's more economical to install Powers thermostatic mixers . . . They cost more. Their safety features make them worth more!

Don McAuliffe, football star on Michigan State's 1952 National Collegiate Champions, enjoying one of the 180 Powers regulated showers in the Shaw Dormitory.

POWERS THERMOSTATIC WATER MIXER complies fully with Veterans Hospital safety requirements in Federal Specifications WW-P541a.

THE POWERS REGULATOR COMPANY
SKOKIE, ILLINOIS

OFFICES IN OVER 50 CITIES IN U.S.A., CANADA, AND MEXICO • SEE YOUR PHONE BOOK

(b43)

OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

Mills all sides of aircraft fitting in 5 minutes flat . . . *with help of* TIMKEN® *bearings*

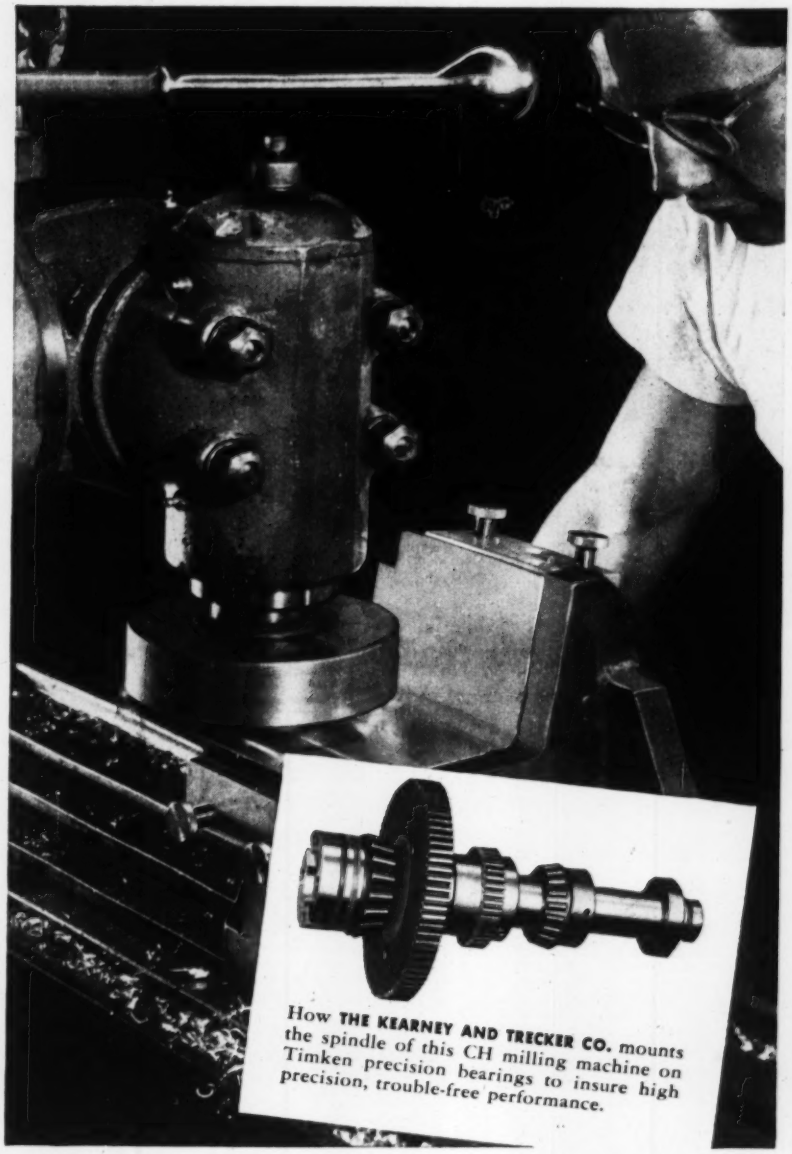
MAKING cuts .050″ deep in 75ST aluminum alloy, this Kearney & Trecker Model CH milling machine mills all sides of an aircraft fitting in five minutes. Even at these high milling speeds, spindle rigidity is maintained—the spindle is mounted on Timken® tapered roller precision bearings.

Line contact between their rollers and races gives Timken bearings extra load-carrying capacity. Their tapered construction takes radial and thrust loads in *any* combination and permits fine bearing adjustment. Result: shafts are held in rigid alignment. Shaft deflection is minimized and end-play can be eliminated. Gears mesh smoothly. Spindle precision is assured.

Timken bearings' tapered construction also makes them easier and less costly to assemble. No auxiliary thrust washers are needed. Spindle maintenance is simplified.

No other bearing gives you all these advantages. Specify Timken precision bearings in the machine tools you build or buy. Look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

TIMKEN BEARING EQUIPPED — *This symbol on a product means its bearings are the best.*



How **THE KEARNEY AND TRECKER CO.** mounts the spindle of this CH milling machine on Timken precision bearings to insure high precision, trouble-free performance.

IT'S TIMKEN BEARINGS FOR VALUE!

To get the best value in bearings you may find this simple formula helpful:

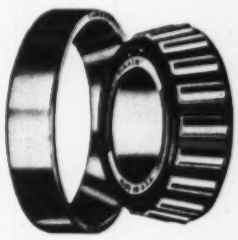
$$Value = \frac{quality + service + public\ acceptance}{price}$$

Obviously a big advantage *above* the line gives you more value than a small one *below*. No other bearing can match the uniform high quality, engineering and field service and overwhelming public acceptance you get with Timken bearings.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ↓ AND THRUST → ← LOADS OR ANY COMBINATION →↓←